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Ultraviolet Space
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System Details

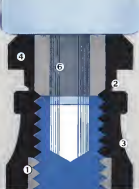
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Sikorsky S-61L



Aircraft Nuclear Propulsion Program Report



*HI-LOK

by VOI-SHAN

Consistently extended period, maximum size and weight, plus speed of installation are outstanding advantages of the new Hi-Lok fastener now being produced by Voi-Shan. The Hi-Lok is the result of a design effort to provide an advanced fastener incorporating its many desirable features in one size, with the greatest adaptability, in one product. Hi-Lok is driven from one side of the work, drawing down in installation costs. Power tooling is also added to bring savings. Automatic, automatic torque control is incorporated by means of a closely controlled shear process. In excess of 100 million available in a wide range of sizes and materials combinations. The Hi-Lok is produced with the accepted Voi-Shan precision workmanship and quality control for maximum performance. Rules for further details and specifications.

1 Grip strength: 1/16 inch min. Counterbore diameter min. 1/16 inch min.

2 Progressive tightening: Hi-Lok is driven from one side of the work, drawing down in installation costs. Power tooling is also added to bring savings.

3 Weight savings: Hi-Lok is much lighter than conventional AN bolt, nut, washer combination.

4 Clearance: Hi-Lok pin head and collar diameters allow greater clearance. The "torque off" has wrenching action projects to allow great tool accessibility.

5 No inserts in hole: Improves fatigue life. 100° counter sink, close tolerance, ultra-fine style and sealing compound are used in fastening assemblies.

6 Silent installation: Automatic and high speed power tool use in fast and quiet. Head test installation and is made in one and permits use of the Hi-Lok gun.

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A Division of Voi-Shan Industries, Inc.
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AVIATION CALENDAR

(Continued from page 1)

Mar. 19-South Atlantic Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Sheraton Hotel, Washington, D. C.

Mar. 9-16-Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia

Mar. 9-16-Flight Propulsion Meeting, in state of the Advanced Science, Cleveland, Ohio (classified)

Mar. 12-16-Nuclear Conference, American Society of Mechanical Engineers, Sheraton Hotel, Los Angeles, Calif.

Mar. 15-17-Flight Testing Conference, American Rocket Society, Los Angeles

Mar. 21-26-Tech. Operations and Support Conference, American Rocket Society, Air Force Hotel, Los Angeles, Calif.

Mar. 20-25-74th National Conference on Aviation Electronics, Mayflower Hotel, Washington, D. C.

Mar. 22-25-International Convention, in state of Radio Equipment, Columbia and Waldorf Astoria Hotel, New York, N. Y.

Mar. 25-24-1961 Western World Exposition, American Society for Metals, Los Angeles, Calif.

Mar. 25-30-1961 Symposium on Temperature, Its Measurement and Control in Science and Industry, Columbus, Ohio

For information: V. M. Sikes, Instrument Society of America, 315 Sixth Ave., Pittsburgh 12, Pa.

Apr. 4-6-International Symposium on Electromagnetic and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 6-7-Lifting Research Vehicle Symposium, Monterey & Design, Anaheim, Calif.

Apr. 10-11-Spring Meeting, Western States Section/The Combustion Institute, Aerospace Division of Ford Motor Co., Newport Beach, Calif.

Apr. 17-20-1961 Traditional Conference, International Air Transport Ass., Queen Elizabeth Hotel, Montreal, Canada

Apr. 20-22-Symposium on Chemical Reactions of the Lower and Upper Atmosphere, Stanford Research Institute, Menlo Park, Calif.

Apr. 20-22-General Meeting, American Mechanical Society with the American Chemical Union, Washington, D. C.

Apr. 25-27-Engine Society Propellers and Gasoline Conference, American Rocket Society, Palo Alto, Calif.

Apr. 30-May 4-1961 National Aerospace Symposium, in state of the Advanced Science, Dallas, Texas

May 3-16-National Aeronautical Electronics Conference, in state of the Advanced Science, Dallas, Texas

May 9-11-Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 22-26-National Telecommunications Conference, Sheraton Hotel, Chicago, Ill.

May 25-26-74th French International Air Show, Le Bourget, Paris, France

Sept. 6-13-1961 Flying Display and Exhibition, Society for British Aircraft Construction, Farnborough, England



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KNOW YOUR ALLOY STEELS . . .

This is one of a series of photographs dealing with heat treating alloy steels. Though much of the information is elementary, we believe it will be of interest to many who may find it useful to review fundamentals from time to time.

Methods of Carburizing Alloy Steels

Carburizing is a means of impregnating the surface of steel with carbon, usually to very limited depths. Its purpose is to provide a hard, wear-resistant "case," or outer shell. Alloy steels, correctly handled, can be case-hardened without sacrificing desirable core properties.

There are three types of carburizing in general use:

Liquid Carburizing—The medium here is a hot-salt bath composed basically of cyanide compounds. The steel is immersed in the bath, the period of immersion depending upon the analysis of the steel and the depth of case desired. Liquid carburizing is a convenient method of producing thin, hard, wear-resisting cases, generally within the depth range of 0.02 to 0.03 in. However, deeper cases may be obtained, the actual depths depending upon economics and end uses.

Gas Carburizing—This method employs a furnace in which a carbonaceous atmosphere is created; i.e., gases that are high in carbon

components, or those containing carbon. Steel subjected to gas carburizing can be case-hardened to depths generally ranging from 0.01 to 0.04 in. When quenching takes place immediately after carburizing, distortion can be kept to a minimum.

Pack Carburizing—Where the pack method is used, the parts to be carburized are buried in a container of dry carbonaceous materials. The container is sealed tight to prevent the infiltration of air, placed in a furnace and kept there for eight hours or more, the actual time depending upon the depth of case desired. Pack carburizing is particularly suitable where a deep case is essential (0.06 in. and over), although medium cases in the 0.04-to-0.06-in. range are possible.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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Because of the added quality of flexibility, Min-K's unique insulating characteristics now can be used in virtually unlimited new applications. For full details on Flexible Min-K, Min-K and other J-M aircraft insulations, write Johns-Manville, Box 14, New York 18, New York. In Canada: Part Credit, Ontario. Cable address: Johnmanv.

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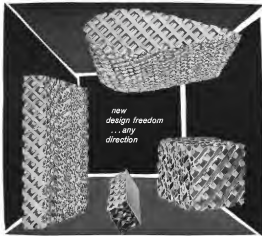
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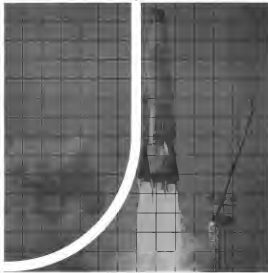
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EDITORIAL

Moving Toward Mobility

Last week we attended the Air Force design engineering symposium of the mobile Minuteman at one of Boeing's Seattle plants. It was probably the first Air Force DRI exercise ever attended by the top executives of the nation's missile. For mobile Minuteman a being born out of an unusual marriage of the railroad train, a clearly, respectable form of transport, and the newest and youngest offspring of the intercontinental ballistic missile family which is still in its infancy and has only recently begun to achieve military respectability.

Strategic Air Command and the Association of American Railroads will form a partnership in providing an element of mobile strategic defense that few military projects would have dared to project several years ago. It still may be hard for some observers to realize that the rail-borne Minuteman can reach its intercontinental targets faster than the supersonic bombers of SAC. Certainly no Air Force officer ever in service ever visualized his duty station in a 24-hr. day calling along the 103,000 mi. U.S. railroad network or sitting on a siding in the launch control car of a Minuteman train inside a locked compartment with his capsule-launching officer on the other side of a bulletproof glass partition.

In the hands of both launch control officers, locked in an opposite sides of the bulletproof glass, will be keys that, when inserted in the proper slot and turned simultaneously, can fire five ICBMs at chosen targets. By 1967, the first of more than 100 of these SAC Minuteman trains will be operational, moving at random over 900,120 mi. track patterns on a two-track data line.

Strategic Deterrent Changing

The mobile Minuteman is another example of how the concept of mobility and complexity is changing the basic character of the U.S. strategic deterrent forces. The fixed, hardened Atlas and Titan sites so well observed against us must in the distance, with their views increasing as SAC's capability of maintaining and operating them on an extremely high plateau of reliability increases. But they now represent a distinctly and relatively complex, and expensive first generation of operational ICBMs that was absolutely necessary both in the technical development history of this unique weapon and in the current military equation.

Minuteman is one of the second generation missiles that offers major improvements in lower reaction capability, greater reliability and better mobility plus major reductions in procurement and operation costs. There is tremendous military and industrial pressure generated behind its development, aimed at achieving the expense paid for Atlas and Titan programs to respond to an absolutely maximum in time cycle to first operational capability. For all the promise of its economy, reliability, quick reaction time and mobility are reduced in fact, the Minuteman can provide a major improvement in both quantity and quality of the U.S. strategic strike force. It also can considerably upgrade our deterrent

capability in relation to any potential aggressor.

Although the hardened, fixed Minuteman installations will offer some of these advantages, it is in its mobile, rail-borne deployment that this missile will apparently make its greatest contribution. History has shown a very poor effectiveness record for fixed military installations ranging from the Chinese wall to the Maginot line. All of these fixed defenses fell before an enemy strategy based on mobility, so it is interesting to see the concept receiving new impetus in the strategic deterrent force.

The Navy's Polaris-class, nuclear-powered submarines are certainly a valuable element in utilizing the vast reaches and depths of the sea to provide mobility and concealment. The mobile Minuteman offers similar possibilities for land-based ICBMs, although we think SAC is suddenly sacrificing some of the possibilities for concealment by mounting that its missiles must be painted standard Air Force blue and be carried by conventional, spacious blue and white-stained belly-bands incorporating the SAC insignia. Since they will be powered by steam and locomotives with railroad markings, these missile trains might appear less conspicuous either on the road or at their temporary siding stops if they bore the standard commercial livery of freight trains.

Airborne Missile Platforms

Another element of increased mobility will be added to the deterrent forces by airborne missiles such as Honest Dog and Skybolt. USAF has shown considerable imagination and technical boldness in pushing toward solution of the air-launched ballistic missile problem. But it has not exhibited similar characteristics in developing suitable airborne launching platforms for this weapon. The B-52, while adequate for current use as a Skybolt launching platform, is certainly not the best that could be devised to provide an airborne mobility for ballistic missiles similar to that provided by nuclear-powered submarines in the sea or the rail-borne Minuteman on land. Certainly either a Dumbo-type aircraft, using the technology of boundary layer control to gain its maximum desired in maneuverability, or the nuclear-powered aircraft still offers greatest promise for a future means of aerial platform and vehicle. Long-range missiles to add a third and equally perplexing element of deterrence to aggression.

The goal of the strategic deterrent in the immediate future must be to diversify and conceal its various elements to such a degree that the possibility of any aggressor being able to eliminate or significantly cripple it by an initial surprise attack is reduced to the smallest fraction of success.

We appear to be well along in bringing mobile deterrent elements into the pattern on land and sea. But the possibilities for an even more elusive and effective airborne element for this combination do not appear to be fully exploited, even by the service that has reared its life in the air.

—Robert Hets

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Washington Roundup

Space Study Group

A committee is being formed to prepare a position paper on the U.S. space program for whatever the Presidential Kennedy commission will do. If Kennedy has a space task force of his own among the groups he has asked to study specific problems, in evidence has not been made known. Meanwhile, George J. Mitchell, George J. Mitchell, and James staff director of the House Select Committee on Astronautics and Space Exploration, is putting together an independent group that will write the position paper.

Already named are Alan Thomas F. Connolly, Navy's astronautics director, Brig. Gen. Robert A. Boush, commander of USAF's Arnold Engineering Development Center, Robert S. Mann, director of Army research and development, Dr. Charles B. Shields, technical director, and Spencer M. Beveland, special counsel of the House space committee. Other members are expected to be drawn from the National Academy of Sciences' Space Sciences Board and from the office of research and engineering in the Defense Department.

As Pease's ambitious space program, much of which is shared at present that would be operating for a more years more, has been generally accepted within the service except for the Positive Control Bombardment Station, as available ICBM (AV) Dec. 4 p. 26). This has been what might have been given doubts among some senior officers about its political acceptability, although most do not question its technical feasibility.

Space Force has become a reality because it has become a project. National Academies and Space Administration probably agrees with some feeling that it is not but we desire to take over development of the proposed national space vehicle from the Air Force. USAF has asked for \$23 million in the next budget to begin work, and now, if its supporters showed that NASA felt it should be given the project because the service had no mission requiring such a vehicle.

NASA feels that if the project is begun, an development will follow a pattern similar to that set by N-15 and Dynabur. USAF provides most of the funding, and NASA provides a large portion of the technical support.

Project Golden Run

Dropping costs of military launchings of Atlas rockets from Vandenberg AFB, Calif., has led to creation of Project Golden Run. The project is an attempt to standardize procedures and establish operational discipline so that it will have some of the program goals when contractor team handles orbital launchers. Strategic Air Command ARDC's Ballistic Missile Division and the major contractors are involved.

Dr. Herbert York, has indicated to intimates that he would like to remain in director of defense research and engineering to the Kennedy Administration. York is a registered Democrat who has remained aloof from politics. He has been on the job for almost a month after recovering from a heart attack. His deputy, John Rabe, also would like to remain in government despite attractive industry offers.

Attempt to set 10 international aircraft records with the Boeing B-50 over 1,000 km. and 2,000 km. closed season but has not yet, apparently for political reasons. Block of 90 days time had been requested, and the records would have been attempted during competitive trials. But the Boeing B-50 has just set a record (see p. 27). The B-50 is not in the Fiscal 1962 budget. The setting of 10 records would undoubtedly have raised congressional questions why the North American B-70 is so vitally needed. So there will be no record attempts.

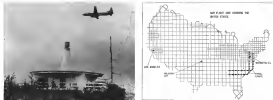
Policy Reins

President-elect Kennedy's choices for Secretary of State and Secretary of Defense are both known as successful men, but it is unlikely that they will have as strong hands in shaping policy in their own departments as their predecessors have.

The nominee for Defense Secretary, Ford Motor Co. President Robert S. McNamara (see p. 25), will have to coordinate national security matters with State secretary Dean Rusk, who is Rockefeller Foundation president and former Under Secretary of State under former President Truman. This will have to be done more completely and with less friction than in the past few years of the Eisenhower Administration.

But observers have also concerned that the real policy-making in both departments will be Kennedy himself. Both his own predecessors in the role of the president and the superintendents of change of study groups in recent years have found this kind of approach to national security.

—Washington Staff



SAFI system installed on FAA Cessna will enable agency to check performance of every navigation aid in the nation at two-month intervals. System permits two-way flight along prefabricated grid paths with aircraft flown under computer control from computer tape.

System to Speed FAA Nav-Aid Inspection

By Philip J. Klaus

Washington—New Semi-Automatic Flight Inspection (SAFI) system, which will enable Federal Aviation Agency to measure the accuracy of the nation's navigation aids with a precision and speed at all altitudes, was accepted here last week by the FAA.

New SAFI system is installed on three FAA Cessna KC-135s, and is being installed on two others which will perform a navigation and inspection mission that previously required 11 FAA aircraft. The agency is planning to install SAFI systems on one or more of its Boeing KC-119 jets to evaluate navigation and performance of stations above 20,000 ft. System was developed by Aerospace Instruments Lab-

oratory, a division of Carter-Hammett. Despite the smaller fleet of inspection aircraft, FAA hopes the new SAFI-equipped Cessnas eventually will permit inspection of the nation's navigation aids at altitudes as low as 1,000 ft. In one month, compared with the four months now required.

An appreciation of the magnitude of the FAA's task in checking out the nation's navigation aids can be gleaned from the fact that there now are more than 800 omni-range (VOR) stations in operation plus another 420 Taurus and 120 of the old civil distance measuring equipment (DME). By 1985, FAA expects to be operating some 1,300 VOR stations (including VOR and Taurus).

The new ALI/FAA system largely automates the checkout procedure. Mag-

nets types prepared by the FAA's Aeronautical Chart & Information Group, which electronically define the precise flight paths to be flown by the aircraft, are used to control aircraft flight through an automatic pilot.

Performance data on navigation aids being checked during the run is recorded in digital form on magnetic tape aboard the aircraft. Following the flight, these tapes are sent to the FAA Oklahoma City facility where they will be specially analyzed and processed by an International Business Machine Corp IBM 704 computer. The use of the computer not only greatly speeds up the data reduction process but also permits much more detailed analysis of individual station errors than previously possible.

The traditional method of checking VOR and Taurus stations required the aircraft to orbit and fly radially to and from the station while its bearing to the station was visually determined by an observer at the station using an optical theodolite. Beyond ranges of accurate visibility, ground landmarks had to be used to determine aircraft position relative to the station.

This old technique posed problems of coordination between aircraft and ground observer and was limited to lower altitudes and favorable weather conditions for visibility. Also, at higher altitudes the use of landmarks for determining aircraft position is increasingly impossible.

An added drawback of the previous methods was that the data was obtained in a form requiring considerable manual effort and which did not lend itself to the use of computer analysis. With the new SAFI system, the use of ground observers and visual sightings on landmarks is completely eliminated.

permitting operational checks at all altitudes of weather and at any altitude.

Aircraft position is precisely determined by means of distance measuring equipment to two ground VOR, Taurus or dual DME stations, one located along the aircraft's flight path and the other approximately at right angles to it. Two alternate ground stations are programmed into the flight tape in the event either of the two primary stations should be inoperative at any time.

The use of distance measuring equipment to determine aircraft drift enroute to the ground stations is considered the most accurate means of establishing aircraft position and setting up special additional ground facilities just for this purpose. The distance measured between the ground stations is obtained by the ground equipment which has been modified to minimize instrumentation error.

In addition to these reference methods to determine aircraft position, each of the FAA aircraft also is equipped with airborne VOR, DME and Taurus receivers which also have been modified to measure reference station signals as measured enroute.

Navigation aids are checked in a sequence of ground station arcs. Each FAA Cessna carries 41 Taurus sets, 11 VOR receivers and four sets of DME sets. These numbers of equipment may vary by aircraft. The IBM 704 computer is programmed to check out 20 VORs and 25 Taurus sets the latter replacing dual DME sets at the old DME ground stations where discommodities.

Grid Inspection

The use of automatic flight and data reduction techniques in SAFI will enable the FAA aircraft to fly a much more efficient navigation and inspection mission. The aircraft will fly a series of ground station arcs at a fixed altitude and a constant speed of 180 knots per hour around each station at 10 ft.

The use of grid flight paths enables an FAA inspection aircraft to obtain performance data on a large number of stations in a single flight, with coverage of data obtained on different flights being performed subsequently by the IBM 704 computer. The grid flight paths resemble the accuracy of a standard data formerly obtained when fixed station flight paths were employed.

The grid lines which the aircraft then are separated by approximately 10 ft in most parts of the country except the high density "golden triangle" (Boston-Chicago-Washington) where the grid line separation is 40 ft.

Using the grid flight plan, an FAA Cessna can check out an arc in 17 seconds in a five-hour period which previously required nearly 180 ft of flight time.

The IBM 704 is used to prepare the individual inspection flight tapes. It also permits the determination of which stations will be within receiving range of the

aircraft for its particular flight path and altitude. The IBM 704 then computes the aircraft's drift enroute from the aircraft to base selected ground stations, one ahead of the aircraft, one behind, one to its left and one to its right as a function of the aircraft's moment about its selected ground stations.

The computer also calculates what the aircraft's bearing will be relative to each VOR. Taurus station with respect to range at every station in its inspection run. This is also recorded on the flight tape and continuously compared with actual VOR Taurus bearing readings obtained in flight. If bearing error exceeds certain limits the FAA inspection crew is automatically alerted by the IBM 704 computer to shut down the current flight.

The flight tape also contains pre-recorded information on the operating frequency of each station within the zone which automatically alerts an in-flight aircraft to the correct frequency.

Bearing and distance measurements are continuously being reported to the computer simultaneously from two tape transmitters in precision ground line at recorded data. Tapes subsequently are returned to Oklahoma City for analysis by the IBM 704. Measurements are recorded every 10 ft second during the flight, corresponding to a distance of 0.04 mi at an aircraft speed of 225 kt.

Swiss Delay Jet Fighter Selection

France, Switzerland-Swiss parliament expects to reach a final decision on the selection of a new fighter aircraft for the Swiss air force sometime during the first half of next year, possibly during its March session.

Technical schedule was announced by the Swiss military control center this month, which, as expected, (SW) Oct. 31, p. 23) the French Dassault Mirage III-C and Swedish Saab 37 (S-37) are the two contenders for the Swiss order for 100 aircraft valued at around \$125 million—demonstrated their capabilities to high military and government officials.

Both aircraft gave impressive proof during the demonstration of their ability to fly at the air force's range requirements—mainly short takeoff and landing distances and high altitude capabilities, enabling them to operate from the narrow Swiss military airbases on the mountains.

A Dassault brochure also talked of the Mirage III-C's 2,700 ft, landing distance with full takeoff weight. The aircraft is also capable of flying at 10,000 ft, altitude, in 10 sec or less, as little as about 1,800 ft in descent. Without afterburners, thrust

Also recorded on the airborne flight log are periodic measurements of VOR station position error, station altitude, aircraft altitude and other implemented data. All data communications between the flight crew and the ground control are via the data link also recorded on the mission log.

Using the IBM 704, FAA will be able to process and analyze tapes from four of its inspection aircraft within an eight-hour period. The results printed out by a separate plotting device show in graphic form the bearing and distance measuring equipment accuracy of each FAA station. The data also is preserved on historical magnetic tapes for future comparison with subsequent flight tapes to determine any possible deteriorating performance.

The SAFI installation in each Cessna includes navigation receiver and maintenance instrument costing \$5,000 ft. The ALI, consisting of the development of the system and its installation in the six aircraft totaled about \$3 million.

FAA anticipates a training facility of the development of a complete system and techniques for operating inspection equipment facilities using technical aids. Various systems are in development with a small portion of the system already in place. The FAA inspection aircraft can precisely determine its position during the first approach.

of the Swiss Air Force is 13,200 ft, but a modern aircraft would be able to fly at a lower altitude. The budget adds an additional 1,300 ft.

The speed of the jet is listed as Mach 2.1.

Dassault requires between 1,600 and 1,800 ft for the aircraft and 3,312 to 3,565 ft for the landing with full gear, while according to Saab, its speed is at the Mach 2.15 range. Its full takeoff distance is 1,120 ft.

Sweden was regarded as a strong position to obtain the Swiss order. Out of the reasons behind this opinion is that Sweden is much closer to the Swiss than any other country. It is also one of its military, missile and rocket ranges for the testing and training it would require if the Swiss is chosen.

France is not able to offer similar facilities, and Switzerland has none of its own.

Another factor in the Swiss's favor is the fact that both Sweden and Switzerland have previously received a "neutral" status and both are members of the European central power economic community whereas France is a member of the central power.



HEAVILY instrumented FAA Cessna, used for navigation aid inspection flights, can carry 21 VOR receivers, 11 Taurus and four DME sets, plus equipment for recording station performance on magnetic tape at digital rates.

Tory II-A Nuclear Ramjet Nears Testing

By Russell Huxley

Mercury, Nev.—Testing of the Tory II-A experimental nuclear ramjet engine submersible has begun here and first run of the complete engine is expected early in January.

Tory II-A is the first nuclear reactor designed to operate in conditions similar to those required on the ocean floor of a nuclear engine in flight. It will be followed by Tory II-C which will also be a swimming but deeper in the Naval Academy and Space Administration Atomic Energy Commission Joint Project Pluto. Tory II-C is expected to be ten times as large as the first, propulsion system. Unlike Tory II-A, its reactor control system will be designed to meet the requirements of flight. It Project Pluto uses of loading containers at the present level, Tory II-C testing should end in late 1962 (AW Mag. p. 56) and the project should end with it since no other phases are planned.

Since USAF cancelled Project Shrike there is no existing reactor or engine equipment for a nuclear engine. However, testing has continued on the development of atomic reactors and nuclear navigation systems used in an unmanned nuclear engine aircraft. Project Pluto engine, in this regard, designed for March 1964 at altitudes between sea level and 1,000 ft.

Two reactors called Tory II-A and II-C will be used in the present phase of the project. They are made in design but the fuel elements are same. Powered by different techniques. Reactors for AI are made by General Electric Atomic Reactor Propulsion Department and those for AI are made by North American Aviation Atomic International Division. Elements for Project Pluto will be made by the Convair Propulsion Co.

Tory II-A reactor core is made up of about 190,000 hollow, hexagonal fuel elements made of a tungsten-graphite alloy of enriched uranium and beryllium oxide. These are fabricated by General Electric Atomic Reactor Propulsion Department at Decatur, Ohio. Each fuel element is about five inches long and about a half inch in diameter. The elements are stacked in and to end layers to a total length of 45 in. All layers are housed within hexagonal structure to prevent the flow of fuel elements from shifting apart. Diameter of the core is 32 in. The first 16 in. and the rest two inches of the core is made of most elements of pure beryllium oxide acting as neutron reflector. A depletion of enriched elements per cent deficiencies and current against fuel load distribution.

The air supply in the Tory II-A reactor is air 401 is designed to deliver 270 lb of air per second at 100,000 psi and 1,000 ft. With the reactor operating at full power the 170,000 lb of air stored at 1,000 psi would allow run up to 90 sec. long. The pressure differential between the inlet and outlet of the reactor enters a pressure of 100,000 lb. again the core. The core is housed against this force by a molybdenum hexaplate suspended from the engine structure in its 44 feet by 77 inches after engine runs at the corners of the hexagonal fuel structure. The shell is also of high temperature metal alloy. Design and construction of the reactor is 2,500 ft. Temperature is 1,900 ft. and reactor power is 150 thermal megawatts. The choice of design by General Electric is maintained by building the core of many small enriched elements.

To increase cost, Tory II-A was made as small as possible. Tory II-C will be a much larger reactor. To get

critical mass with minimum cost and expenditure of fuel, Tory II-A was designed with a two-foot-thick graphite neutron reflector around the core. The reflector is split vertically to make it possible to install and remove the reactor core, it contains eight neutron control rods. Each rod is a core of boron metal rods in the side of a solid graphite cylinder that can be rotated within the graphite shield. Boron is a neutron absorber and reduces the neutron flux in the core. The rods can move at the rate of 0.5 sec. Four boron boronated control rods permitting the core to be used for fast power changes and are capable of removing the reactor within 0.2 sec. Valves and rods are both hydraulically actuated.

There will not be measured in the Tory II-A test. Margaret Corp. major engine contractor in the project, designed the reactor mostly to keep pressure on the reactor core and to prevent air from going anywhere in the reactor. It is being applied to measure ground contamination. The purpose of the test is to demonstrate the feasibility of using a nuclear reactor as a propulsion and at the same time use the air to cool the reactor. The heat of the nuclear reaction is transferred directly to the propellant from the reactor through the wall tubes in the fuel elements. The tubes make up about half the construction of the core.

The graphite reflector is cooled by heavy water pumped through channels bored in the graphite. Heavy water is a better neutron reflector than ordinary water which is used to cool the reactor. This 40 sec. power core heats boron supply cooling air to dissipate residual heat for the two heat exchangers.

USAF C-130s Airlift Austrians to Congo

Washington—Five Lockheed C-130 transport aircraft of the Air Force's 32nd Air Division, which commanded the mission effort, U.S. military to the Congo last summer, were scheduled to complete a mission to the same sub-Saharan country last week.

At United Nations request, the C-130s were airlifting 40 Austrian medical personnel and 33 tons of supplies to Congo. Austrian government the 16th anniversary to be flown to the Congo by U.S. aircraft since the Congo crisis began in June, ended the Air Force's initial relief flight to 17,500 persons and seven million tons of cargo.



Revolutionary RCA Magnetic Video Tape Recorder to Speed Navigation Training of Submariners

Along with the nuclear submarine Sea Dragon, the first underwater magnetic video tape recorder will record and store data on under-the-sea characteristics from externally installed TV cameras. Upon return to base the recorded information will be displayed for the benefit of underway service technicians.

The RCA underwater recorder is a marvel of compact design (dimensions 39" x 39" x 100"). It weighs in at a tapered rack, and represents a 60% space reduction over existing video tape equipment.

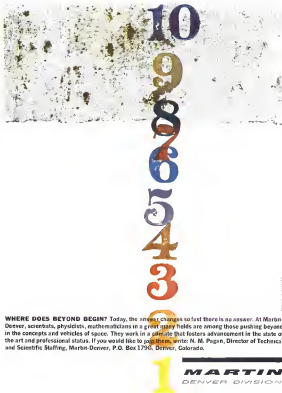
Among the exclusive RCA developments are: the new famous "T-100" satellite recorder; a video system designed to take the first pictures of a mine case re-entry vehicle; a unique tape cartridge completely adaptable to any tape recorder. For literature describing new RCA defense and commercial products developments, write Defense Electronics Products, Radio Corporation of America, Camden, N. J.

Out of today's defense needs... tomorrow's electronic advances



The Most Trusted Name in Electronics
RADIO CORPORATION OF AMERICA

TORY II-A is the first nuclear reactor designed to operate in conditions similar to those that would be imposed on the reactor of a nuclear engine in flight.



WHERE DOES BEYOND BEGIN? Today, the answer changes so fast there is no answer. At Martin-Denver, scientists, physicists, mathematicians in a great many fields are among those pushing beyond in the concepts and vehicles of space. They work in a climate that fosters advancement in the state of the art and professional status. If you would like to join them, write: N. M. Pagan, Director of Technical and Scientific Staffing, Martin-Denver, P.O. Box 1790, Denver, Colorado.

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Project Phoenix Aimed At Cheaper Launches

Washington-Air Force's Project Phoenix is aimed at making future launches of large space vehicles as common and as reasonable in cost as launches of B-1 bombers.

The Phoenix studies (AW Dec. 5 p. 10) are an attempt to integrate the best features of all phases of vehicle launching operations into a streamlined approach that would be valid for at least 18 years.

Development of studies going out of the studies is expected to begin next year. Test launches would begin in 1984, and the system would be operational by 1985.

Work now is being done by Aerospace Corp., the Rand Corp. and Air Research and Development Command's Ballistic Missile Division. Initial review milestones are expected to go to DMDD by the middle of next year. Aerospace is handling design work. Based on this Rand will conduct economic studies.

Phoenix work is being done toward technically in Defense Department facilities. Missile Community evaluations of low-cost upper stages for space vehicles.

Emphasis in the Phoenix work, for example, is on the launching of vehicles and space probes rather than missiles. But the advantages would apply equally to other type of weapon systems. USAF has established a requirement for an 800,000 lb booster in connection with Phoenix, but the studies are much broader than just development of a low-cost booster. Aspects of the studies are:

- **Missile launch complex design**, including new concepts in ground support equipment.
- **Low vulnerability**.
- **Quick reaction time**.
- **Extended shelf life** of booster components. Currently, Phoenix concepts probably will be applicable to launching of non-military vehicles.
- **Reusable boosters**.
- **Flexibility**, including the ability to handle solid and liquid propellant rockets conventional or exotic fuels and boosters of various sizes.

Nuclear Test Facility

Washington-Term of Ralph M. Parsons and Thibault Chemical Corp. was selected last week in National Aeronautics and Space Administration to conduct a four-month design study for the National Nuclear Reactor Development Facility (AW Dec. 5, p. 10). Contract is worth of \$100,000 will be completed. The study essentially is aimed at defining test facility requirements and recommending a site.

• **Economics**-reliability, and ability to maintain cost.

• **Adaptability** to various environmental and geographic conditions.

• **Utility** leading from rugged, uncomplicated, easily maintained and repaired vehicles and launch facilities.

The likelihood is that facilities resulting from Phoenix will be erected first at Atlantic Missile Range launch site and later at the Pacific Missile Range. PML is Phoenix, among its scheduled range programs.

One Phoenix scheme under study calls for an off-axis, true linear type of launching complex consisting of one central control station for each pair of pads. Bolstering the approach are a number of company studies, both funded and unfunded, that also contemplate various launch complexes (AW Dec. 12, p. 10).

Bids Are Due Dec. 28 On Nimbus Integration

Washington-Bids for the Nimbus weather satellite system integration project are due Dec. 28 at Goddard Space Administration's Goddard Space Flight Center.

Industry also is preparing proposals for the Nimbus spacecraft. Systems integrator will be responsible for packaging the instrumentation, power and sensor subsystems in the spacecraft structure. Builders conference on both projects was held Nov. 28 at Goddard.

Nimbus component contracts already have been awarded to General Electronics Laboratories, Inc., for 17 electronic instruments; Radio Corp. of America, for design and construction of an electronics systems computer lab system model and International Telephone and Telegraph Corp. for a radio meter.

Another Goddard contract expected to be awarded within the next few weeks is the existing geophysical observation (GOCO) controllers for the modular spacecraft (AW Sept. 5, p. 10) include: Avco Corporation, Beverly, Mass.; General Electric, Cincinnati; Hughes Lockheed, Radio Corp. of America and Space Technology Laboratories.

News Digest

Atlas 4000 launch offering pushed back (AW Dec. 15) after the launch vehicle collapsed 68 sec after liftoff and fell in 70 ft of water 3-12 mi off Cape Canaveral.

Communications facility will build three experimental interface payloads under a \$19-million Advanced Research Proj-

ect Agency contract. The three payloads will be launched into 22,000-mi orbits on Atlas Centaur into flight starting in 1982.

Republic Aviation has moved the annual August vacation period back to Dec. 23-Jan. 9 for F-105 production workers. Company and the move was made to permit 7,000 employees to catch up with production.

Rep. Carl Albert (D-Gold.) also who will become chairman of the Joint Congressional Committee on Atomic Energy, the new Congress changed last week that Department of Defense blocking development of Project Pluto as a nuclear rocket engine for a low-level supersonic missile.

Mississippi-Electrovert has won a contract for first phase in the development of an internal guidance system for Dyna-Soar (AW Nov. 14, p. 23). Honeywell Aerospace and Texas Instruments is to develop a guidance system in the Dyna-Soar program under the six-month contract.

American Radio Society has asked the U. S. Court of Appeals to block the recent action of Federal Communications Commission in denying petition of American Telephone & Telegraph Co. and other consumer groups who opposed the granting of frequencies above 300 mc to private microwave users said the system needs of commercial communications facilities are established.

Australia will place on orbit later for 30 Dromedary III interceptors, showing the French Seaquest (AW Sept. 14, p. 10) over the Indian Ocean. The 104 (AW Dec. 5, p. 27). Australia probably will build subsequent aircraft under license but may replace French with U. S. avionics equipment. Another bid also considering the airplane has been approached by Australia about handling design changes in common.

United Aircraft Corp. has acquired 10% interest in Radio Flyer, a French company that has manufactured payload and components for the French Air Force and NATO under license to Canada. Hamilton Standard Division for as others. Other Hamilton Standard products may be added to the company's lines but for sale in the French market common interest.

Amo-Martin Production made its one and successful two-stage flight at the Atlantic Missile Range last week, carrying a 100-lb inertial guidance system to the first stage. Guidance was flown for checkout only and did not control the missile.

Carriers Scramble to Fill Florida Seats

Jet competition into Florida from northern points heavier than ever despite leveling off of market.

By Glenn Garrison

New York—Airlines serving the Florida market look forward to an excellent Christmas-holiday business, but their flags are crossed as to whether traffic over the winter winter season will fill greatly expanded jet capacities from the northeast and midwest.

Miami's growth as a travel market has shown signs of leveling off to the level of competitiveness from other jet-accessible tier 2 areas (AWO Oct. 8, p. 39). Nevertheless, competition on every route into Florida from northern points will be heavier than ever this year, with jets now serving all the major others. Some airline officials believe that seats in anything but jets will be hard to fill during the season.

Airlines will operate 436 million seat miles into Florida from the northeast this month, according to new airline estimates—up from about 375 from last December. From the midwest, the estimated total is 501 million seat miles, an increase of about 35%, according to the carrier. Of the northeast capacity, about 55% will be in jets, the percentage from the midwest will be about 35% jet during December and higher late in the season. Seat-mile north for the rest of the winter season certainly should not be relatively less than the December estimates.

In the New York-Miami market, the jet situation has at least temporarily brought a marked change in the seasonal relative positions. Eastern Air Lines traditionally has the lowest operation on this route, with less fewer jet seats than winter than either of its two competitors, National Airlines and Northeast Airlines. Northeast plans to schedule the most jet seats of the three carriers.

But when pitted and Lockheed Electric turbojets scheduled as reduced, Eastern still will be way out in front as volume of New York-Miami service.

Eastern, with a current jet fleet of 11 Douglas DC-8s, has had to spend its jets to meet competition in away areas.

It also recently inaugurated jet service to Mexico City, a market it has never had prior seasonal.

Increased Competition

Florida faces increasing competition from other tier-one cities as the jets enter tier 2 areas and begin to expand their pattern around the world. Examples of areas competing strongly with Florida as tier-one markets are the Caribbean and Puerto Rico.

Jet service to Florida from midwest-

ern points will keep up volume this winter. Eastern and Delta will offer more jet seats from Chicago and other cities, Trans World Airlines will move to provide jet service from St. Louis. Capital Airlines will cover the jet market with leased Boeing 720s from Pittsburgh and Cleveland. Northwest Orient Airlines' plans are circled in an ongoing state, but if that is settled soon the carrier will schedule jet from Chicago to Miami.

Market Outlook

Here is the outlook of seven airlines which are now presently serving the Florida market:

• **Capital** is leasing two 720s from United Air Lines and plans two daily flights from Cleveland to Miami and two daily flights from Pittsburgh to Miami. The aircraft will be 97-passenger mixed configurations, two will operate as mixed-class service and two as night coaches. From its three main Florida markets—Baltimore, Cleveland, and Pittsburgh—and other Great Lakes area points, Capital will offer 972 daily seats in jets. Douglas DC-8s and a Vietnam Vietnam turbojet. The total total is up about 112 from last month's peak, but flights total 10 instead of 12. This is Capital's third season in the Florida service. The airline expects to do well this season because it will have no jet competition on its Cleveland-Miami and Pittsburgh-Miami runs. From Capital's point of view, Miami offers not only a market in itself but a gateway to the Caribbean from Capital's midwest points.

• **Delta** believes competition in some of its Florida markets will be strong this season, but points out that the winter season is not new. Delta expects to be in a good competitive position, having been first with DC-8s to Miami

1953s from the midwest. As of next month, Delta will be offering 1,891 daily jet seats to Miami in nine flights, up from 991 jet seats in five flights last January. The 1956, in all first-class 54-seat configurations, will serve Miami from Chicago and Cincinnati. Miami will be served from Chicago and Detroit by DC-8s carrying 119 seats in mixed configurations. Including other Florida cities, Delta will be adding 1,542 seats to jet and piston aircraft up from 1,551 last January. Delta feels it will get its share of the Florida market because of its jet position. What the overall market will be this season, according to Delta, depends on such factors as the weather and whether there is an economic recession. In the past, scheduled schedules have been cut back when the traffic hasn't materialized, and Delta will do this again if it becomes necessary. This is not expected, however.

• **Eastern** will be operating a normal 175 flights in and out of Miami this season in jets and from northern cities, up 24 flights from last season. The figure is not include extra services. There will be 16 jet flights a day in and out of Miami to southern points, including New York, Chicago, Boston, Philadelphia and Detroit. Eastern's 115-passenger DC-8s will be competing with jets on every route to Miami. Douglas from New York, Eastern will schedule 145 daily flights to Miami, 516 seats by National and 618 seats by Northeast from Chicago. Eastern's daily jet seat total will be 218 against 240 by North Central (including its stake in United) and 268 by Delta. From Detroit, Eastern's 230 jet seats will be matched by 213 Delta jet seats. Eastern will be serving several Florida points with its jet service. Trips with daily DC-8 flights. West Coast flights with the state including Denver, Dallas and Phoenix will be jets. Eastern plans to offer more than 10,000 seats a day around mid-March to northern points. As for the winter, Eastern is coming believe that seats will be scheduled and has been sold out. Bookings to Florida Eastern reports, up 18% compared with an increase of 100% for bookings to Puerto Rico. Eastern, according to a Delta DC-8 delivery return for getting the most powerful 747 engine, got a late start in the jet competition to Florida. In New York-Miami service, National scored by leasing Jet American's first jet, the 1974-1975 season, and Northeast had 787-320s from TWA the following winter.



New Airport for Moscow

Modern concrete and glass terminal over 1,000 ft long is under construction at the new Domodedovo Airport 15 mi south of Moscow. Terminal is designed to handle approximately 14 aircraft a day at the T4 and terminals will serve international traffic now handled at Sheremetyevo Airport. Passengers will board through covered walkways extending from the building. Traffic pattern will not conflict with those at Moscow's present airports—Vnukovo, Sheremetyevo and Yekino. Runways are nearly complete, and Aeroflot training flights are scheduled to start soon at Domodedovo.

Eastern's last DC-8 service was inaugurated late last January and last season's peak jet frequency was three daily flights in each direction. The winter's total of new round-trip jet flights is in and out of Miami does not include space in a third-weekend, but jet in demand, which is expected to provide 165 seats.

• **National's** jet capacity is up this season, but even all capacity is down. Total seats available this month from jet northern cities to Florida, including some airlines, is the highest in 1956, at 51,420, but December's total was 50,012 seats. National's peak winter daily round-trip jet flights will total six, two of which will be New York-Miami, one Philadelphia-Miami, and one New York-Tampa. In addition, there will be a daily interchange jet flight with Tampa. During the last peak season, National operated four daily New York-Miami round-trip jets with leased Pan American 707-120s, serving 125 seats in mixed configurations. The carrier got its first DC-8s last February, and in February and March inaugurated DC-8 scheduled for Philadelphia-Miami and New York-Tampa. The DC-8s, of which National has ten three, carry 101 seats and 28 first-class seats. National has not leased jets this year.

• **Northeast**, with its 588k leased from General Dynamics, expects to operate a substantial proportion of the jet service between Miami and the northeast this season. For Northeast, the two-year edge in jet capacity is all payable a "wonderful opportunity" and may

enable the airline to get into the black in 1981. Northeast 1981 results will tell the tale the airline feels. Last winter, Northeast operated one daily round-trip jet in its leased 140-passenger 707-120, but otherwise largely withdrew from the New York-Miami market and its heavy competition. The view, with the leased 120 still providing one daily schedule, for 1982 daily round-trip was planned between New York and Miami. From all northern points, to the east coast of Florida, Northeast will fly 31 daily 140 round-trip jets; DC-8 round-trip jets, and the 120 flight for a total of 151 seats in each direction. These seats will be 75% jet. Last winter's jet seat total was 476. The DC-8s which also will operate into other Florida points than Miami, but may be completely withdrawn from Florida by May 1, depending on how the traffic develops. Northeast will be operating from Boston, Philadelphia, New York and Washington to Miami. It is London, Jacksonville and Tampa. During the December and 1979, through April 1980, period, Northeast's Florida traffic DC-8 scheduled for Philadelphia-Miami and New York-Tampa. The DC-8s, of which Northeast has ten three, carry 101 seats and 28 first-class seats. National has not leased jets this year.

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• **Trans World Airlines** will offer one daily jet. Last Miami round-trip service began in 1973-1974, plus two daily Super-C-119 round-trip jets with stops that a leased last season. In addition, a 707-120 will make a Kansas City-St. Louis-Miami round-trip on four peak days of the month, beginning Jan. 10. TWA has no jet competition on this route and feels it will have no problem filling the jets. However, TWA was forced to discontinue the practice of operating its Miami-St. Louis jet on its Los Angeles route with a change of flight number. Civil Aviation Board required the airline to change planes at St. Louis, which it now does at a connecting flight to the West Coast, including the Miami-St. Louis jet. TWA's round-trip jets to Miami will total 508 jet seats and 440 seats

Chosen Instrument Urged on Space Routes

By L. L. Doty

Washington—Initiation of a single route, or chain instrument, operation to replace independent between U.S. flag carrier on low traffic density international routes has been proposed by United Research, Inc., in a report prepared for the White House.

The report, which says that rates external effect an operation continue to be conducted on an economic rather than political level, proposes a traffic chain instrument as the determining factor in judging low area carriers should serve a given route. In addition, the report found that the competition could only a "reasonable distribution" toward national defense and that relatively few revenue routes have sufficient potential to support an all carrier service during the next few years.

The United Research report was issued to coincide with the second half week of the Civil Aeronautics Board final decision in the Transpacific Route Case of the White House. The report followed Executive William Madden's recommendations that competition be removed, the two documents will be in sharp contrast, since Civil Aeronautics Board is expected to recommend a unilateral decision on grounds that traffic in the Pacific area is not promising.

Coincidentally, the Aviation Section, Federal Aviation Administration, on Nov. 10, 1960, announced that it had received notice of the United Research report that the plan and use of a return to a chosen instrument policy is under review as transportation is studied. "It is an international policy to meet those foreign competition seriously," the report said. "It may be that they should implement such action to meet more rather than during from which is a continuous conflict."

Many of the committee's recommendations reflect policy made in previous years, but few discuss instrument one way or the other.

Changes are strong that President Eisenhower will see the report in a guide to a program of dropping the CAB decision in the Transpacific Route but it is unlikely that it will play a major role in presidential decisions on other major areas of the world since the Kennedy Administration views its office.

Here are the highlights of the report: • More than U.S. carrier should operate over a given route only when the carrier can be expected to handle a minimum of 116,000 third and fourth class passengers in both directions at \$5,000 in each direction. This standard applies to longhaul

international routes only. Traffic volume below the 116,000 passengers support adequate, economical and profitable service by more than one airline.

• Multiple designation of U.S. carrier should not adversely affect political relations with foreign governments but it does complicate the task of U.S. negotiators because of conflicts of carrier interests. In addition, multiple designations becomes an impediment to actual relations where land support offered by U.S. carrier may be drawing traffic from foreign carrier.

• No points in Europe or the Middle East in addition to those currently served by U.S. carriers cannot meet their own carrier either now or in the future.

• Expansion of London, Paris and Los Angeles in proposed routes to be reduced to Rome and Frankfurt routes direct and as primary gateways. Traffic at and through London already falls below minimum standards for intercontinental service. Rome and Frankfurt are not served by U.S. carriers as yet.

• Traffic potential from Frankfurt will provide only marginal support for connecting U.S. carrier if the Germany becomes a primary gateway, and suspension of one of the existing U.S. carriers, "presumably Trans World," should be considered.

• Competition by two U.S. carriers at London, Paris and Rome is now warranted and will continue to be warranted, but no second around-the-world service in competition with that offered by Pan American.

• Expansion of U.S. gateway to include major cities other than New York, should be limited to separate routes and should be tested for the number of carriers by the maximum traffic volume. Multiple service at Stockholm and Western Airline "does not appear to have created appreciable competition in our carrier, but it should not be substituted or expanded to handle additional types of traffic."

• Traffic density in the Pacific area, even with substantial growth, will be much less than in the Atlantic area, and traffic from the U.S. East Coast to the Far East over the polar route does not warrant competitive service, contrary to Madden's recommendation. Pan American should not be awarded access to East Coast routes over the Central Pacific route, and Norfolk should be authorized over California gateways for Central Pacific traffic. The report also stated that the U.S. West should receive a Central Pacific

route for reasons other than economic. It proposed Portland/Seattle route to Hawaii should be extended to Tokyo.

• Traffic is not sufficient to support an extension of Trans World's Japan route, which now terminates at Bangkok, in Hong Kong and Tokyo. It, for reasons other than economic, it is concluded that a second around-the-world service is necessary. TWA and Northstar should be joined at Hong Kong.

• Point-to-point competition in North America is excessive, but the report argued that an action should be taken to correct the situation pending a settlement of the government's withdrawal against Pan American, Panagra and W. R. Grace & Co.

• U.S. airline service in North America should consist of a single, First Class service and a single, West Coast carrier competing with one another only at Boston Area. Such a policy could be achieved by resolution of the Panama canal question and the U.S. carrier and the carrier and suspension of Brazil's open route into Rio de Janeiro and Sao Paulo.

In developing its standards for multiple designation, the United Research report started on the assumption that when there is a state or land fixed point of traffic along a route or series of routes the splitting of this available traffic between two airlines has the tendency to reduce schedule frequencies at load factors. "This is a part loss, reduces total revenues and has an adverse effect on our costs."

It stated that the carrier competition, a carrier cannot track a reasonable utilization of its ground personnel and facilities to the point where it can easily absorb maximum status cost and carry well profit.

United Research said that in providing level of rates and fares, a carrier must adhere a certain minimum level. Letter it said in order to run an aircraft operating with a certain higher level of rates, it must do so with operating costs. Division of traffic by competition the report concluded, tends to reduce either load factors or number of scheduled frequencies or carrier capacity. A sharp drop in load factors causes a substantial increase loss, which leaves a carrier with little choice but to cut schedule and thus cut out both the lower utilization of personnel and facilities and costs a loss of traffic because of less attractive schedules.

The report admitted that maximum standards for multiple designation could encourage a single carrier to develop a single flight above that standard for fear of having another carrier placed along side it. On this point, the report said that the proposed standard should not be treated as an absolute rule, but regarded as a basis on which CAB and the President can exercise judgment.

TWA Seeks Early 880 Deliveries; Financing Program Nears Closing

Times World Airlines was working last week to get some of its 880-880 delivery and, until service by Chevrolet. It obstacles are cleared the airplanes probably will go on an extra national and not scheduled flights.

TWA's new 880 on hand which has been used in its training program, was being parked at the TWA terminal base in Kansas City prior to placing it on the line. At least two to three airplanes at General's plant in San Diego could be used for delivery quickly.

Initial Service

Routes likely to get 880 service first include New York-Chicago and Chicago-West Coast, points about United Air Lines and American Airlines have been pushing air service. Another route likely is New York Phoenix where the service is beginning and where American has begun to operate Boeing 737 service. Denver-Chicago and the West Coast is another possible route. Scheduled service will not begin until January.

Closing of the TWA financing program is scheduled for Dec. 31, but may be moved up to Dec. 29. There is still some possibility of a last minute hitch but says Howard Hughes' spokesman as to whether or not this development is real. Because it was expected to use minimum questions on payment for charges incurred by the flight delivery plan (AW Dec. 11 p. 2).

The incident in the Dallas, Texas plan which Hughes offered to accept will show two features on the basis of passenger in the house. Since 880 will have of the total of 5165 million long term debt contemplated will be provided by Equitable Life Assurance Co. and Metropolitan Life Insurance Co., their refinancing could be great in the selection.

Balance of the long term debt—571 million—will be provided by a group of banks headed by Irving Trust Co. and an underwriting of participation about Irving Trust Bank of America, National Trust and Savings Assn., Bankers Trust Co., Mellon National Bank and Trust Co., Morgan Guaranty Trust Co., First National Bank of Boston, Security First National Bank of Los Angeles, the California Bank and the National Bank of Commerce of Houston.

Debtors Offered

In addition, TWA will offer \$100 million of subordinated senior debt from new sources to its stockholders with Hughes Trust Co. purchasing out only 10 percent of the \$75 million but also enough of the debtors not taken up to provide TWA's net \$100 million.

One of the last steps expected will be a reworking of TWA's bond, after which a new prospectus is required to be chosen. The proposed merger with Northstar has been scheduled until Dec. 31 and might be extended further.

USAF Supersonic Transport Policy Outlined

New York—Development of an economic high speed transport is a feasible matter for the U.S. in a time after military is fast to achieve this goal, Air Force Chief of Staff Gen. Thomas D. White told the American Defense Assn. here.

USAF has a fairly strong in a national program to develop a supersonic transport and needs only to make available the money, capabilities and to coordinate its program in the area of development management in any other way it can, it added, he said.

Gen. White noted that some manufacturing applications made on the USAF program at the moment (AW Nov. 18, p. 21) and emphasized that the Air Force did not intend that any supersonic transport must be a modified B-70 Mach 3 bomber.

Gen. White said that only through a national supersonic transport program can the U.S. maintain a world leadership in a technology which is under development. It is necessary to be prepared to assign people to the job. He also said that USAF would now study the feasibility of such a supersonic transport program as military growth alone, but it can focus toward achieving national applications for such an aircraft and would certainly "under proof" one of it if it was developed through a national program.

"It has long been our conviction," Gen. White said, "that the development of a Mach 3 bomber such as the B-70 would open the door to higher speeds and performance by the civil aircraft of the future. This, however, should not be construed to mean that the Air Force feels that a national supersonic transport must be a derivative of the B-70."

There is an excellent transfer of knowledge gained in the B-70 program will allow the total cost and cost of the supersonic transport development program. Furthermore, unless the aircraft which is first developed under the program takes full advantage of the advanced technology of the B-70 in terms of speed and growth potential, it cannot in any open market economically competitive for very long."



Buttresses Support Roof of TWA's Idlewild Terminal

Construction of Times World Airlines new passenger terminal at New York International Airport weighs 11 million lbs and is supported by four buttresses. Terminal is expected to accommodate 750,000 passengers during 1962. Its first use opening in 1963. The terminal is a 1,000,000 sq ft building with 1,000,000 sq ft of area. A subway will connect terminal building with area shaped building occupied with area gates for immediate accommodation of area traffic.



NEW SPEED, NEW VERSATILITY, NEW ECONOMY

WITH THE VERTOL 107-MODEL II

The new twin-turbine powered Vertol 107 has inaugurated a new era in helicopter operations. New York Airways has already ordered ten of these tandem-rotor helicopters in the luxurious airline version. Five will go into service by the spring of 1961, providing New York Airways passengers with the comforts now enjoyed in conventional fixed-wing aircraft. For greater passenger convenience, Vertol's unique mobile baggage container can be removed, unloaded and replaced in minimum time, eliminating one of the most annoying causes of passenger delay.

Airline operation is only one of the many applications for the Vertol 107-Model II. Its twin-turbine reliability and ease of handling—its altitude and speed characteristics—its water-landing capabilities—its extra-large cargo capacity and straight-in rear loading—its ability to haul loads internally, externally or hoist-in, hoist-out—all add up to new speed, new dimensions in versatility and new economy for many commercial and industrial applications such as petroleum, mining, logging, and construction.

For complete details on the Vertol 107-Model II, write: Commercial Sales Manager.

VERTOL DIVISION
BOSTON **BOEING**
RENO, NEVADA



Airline Traffic—October, 1960

	Revenue Passenger-Miles (RPM)	Revenue Passenger-Miles (RPM)	Load Factor %	U. S. Mail Tons-Miles	Express Tons-Miles	Weight Tons-Miles	Total Revenue Tons-Miles	Overall Revenue Load Factor %
DOMESTIC TRAFFIC								
American	489,470	136,790	44.8	1,773,201	1,744,442	10,933,359	49,150,951	54.7
Boeing	170,484	136,434	80.0	672,403	136,207	499,347	10,108,318	67.6
Continental	310,916	126,474	40.7	367,456	221,558	541,541	10,409,448	59.7
Commodore	116,441	75,364	65.2	234,501	138,909	267,421	5,161,950	43.8
Delta	273,320	156,935	57.4	409,433	361,773	1,232,413	11,204,472	49.7
Eastern	404,420	215,123	48.9	1,912,116	644,699	2,762,449	26,616,438	29.10
Eastern	159,178	76,313	47.9	291,349	42,149	141,191	1,791,363	24.9
Midwest	133,302	40,661	30.5	123,163	51,216	129,426	4,311,304	41.3
Midwest	133,302	105,143	80.9	440,165	304,434	1,204,150	10,444,126	47.6
Texas World	438,116	219,332	50.3	1,464,772	643,399	4,232,225	29,896,609	51.6
United	773,338	316,440	40.9	3,414,897	1,649,361	7,461,184	44,294,903	28.3
Western	133,470	72,434	54.4	393,504	174,141	348,159	2,466,562	53.6
INTERNATIONAL								
American	6,910	6,717	41.4	19,298	2,291	194,479	1,428,452	42.1
Boeing	5,182	11,322	82.3	42,400	194,479	194,479	1,000,469	44.8
Continental	16,390	1,600	10.7	3,027	4,493	978,009	61.8	
Delta	1,349	2,211	59.4	1,259	37,008	396,320	31.8	
Eastern	26,387	36,042	67.86	133,187	288,739	5,646,104	41.19	
Eastern	6,414	1,614	25.0	1,208	58	1,149	190,429	50.3
Midwest	3,135	2,793	79.9	1,208	6,866	376,474	66.7	
Midwest	13,399	21,307	59.8	1,234,244	12,763	933,140	4,401,886	56.4
Texas World	4,458	5,577	49.8	33,201	261,584	793,120	32.8	
Texas World	163,178	175,254	89.7	1,454,888	2,230,002	16,627,701	23.6	
United	1,349	2,211	59.4	1,259	37,008	396,320	31.8	
United	40,242	164,034	70.6	2,634,892	6,801,105	35,791,837	49.8	
Western	10,049	17,375	59.9	69,206	334,299	2,461,583	26.9	
LOCAL SERVICE								
American	44,704	13,433	42.6	19,176	38,718	23,702	1,411,469	41.8
Boeing	14,268	5,991	42.0	7,738	4,700	11,110	837,130	43.7
Continental	13,193	3,048	41.7	4,461	4,203	10,289	264,176	38.6
Delta	29,123	8,247	40.0	28,714	19,417	67,112	866,371	55.4
Eastern	14,268	5,991	42.0	7,738	4,700	11,110	837,130	43.7
Midwest	40,493	19,369	47.9	19,890	21,131	31,608	1,312,144	43.3
North Central	31,303	14,712	47.33	21,261	19,344	19,327	1,312,198	46.69
United	14,303	5,470	46.3	18,746	20,479	37,607	1,274,177	46.4
United	42,201	8,861	47.6	16,183	16,240	21,836	899,469	49.6
United	31,799	7,494	42.46	15,190	5,483	12,723	776,398	40.98
SAVING TRAFFIC								
American	24,229	3,921	63.1	5,307	5,764	322,723	43.6	
Boeing	14,112	7,494	69.9	4,164	215,103	844,143	53.6	
CARGO TRAFFIC								
American	2,708	15,269	79.1	55,919	40,498	11,405,764	19,855,767	75.9
Boeing	1,478	19,811	84.7	19,811	44,792	3,024,164	5,122,797	77.9
Continental	1,740	6,463	108.0	945,883	4,447,061	30	472,402	27.9
Delta	2,670	24,703	108.0	945,883	5,248,807	9,846,348	72.3	
Delta	1,740	6,463	108.0	945,883	2,305,323	4,447,061	169.0	
HELICOPTER TRAFFIC								
Chicago Helicopter	17,736	479	69.2	1,199	1,199	48,768	48.8	
Los Angeles Helicopter	2,721	87.5	69.2	1,199	1,199	16,707	24.6	
New York Airways	15,769	299	53.1	1,847	802	316	35,793	53.6
ALASKA TRAFFIC								
Alaska Airlines	9,434	9,411	99.8	42,915	4,760	427,204	1,342,200	42.0
Alaska Central	4,249	431	56.8	4,303	5,449	60,169	64.8	
Alaska	1,349	103	24.7	3,671	48,937	78,202	49.7	
Alaska Central	1,880	362	36.4	40,443	48,937	176,911	52.1	
Alaska Helicopter	9,274	4,891	44.4	152,313	12,906	419,072	3,556,474	49.9
Alaska Helicopter	1,173	1,284	27.6	12,731	76,413	148,871	39.3	
Alaska Helicopter	20	414	99.0	741	1,188	4,668	52.0	
Alaska Helicopter	2,842	568	91.9	44,297	91,233	194,423	59.6	
Alaska Air Transport	2,796	240	43.8	455	395	10,495	49.9	

Not available. *No significant this month. *Extension granted due to destruction of aircraft by fire. Completed by Aviation Week from airline reports to the Civil Aeronautics Board.

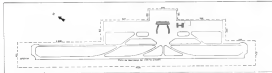


First aircraft to land at new Lima-Callao International Airport was this Boeing Douglas DC-4 en route from New York to Buenos Aires. The 414-one-hundred airport, which replaces Leonardo Airport, was completed Oct. 29. Airplanes were delayed until construction of a two-mile double-lane access highway and a four-lane bridge over the Raimon River were completed.

New Lima-Callao Airport Designed for Jet Traffic

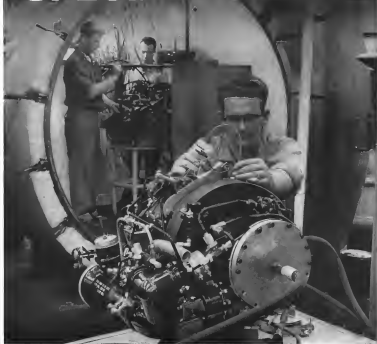


Located about 6 mi. from the business center of Lima, the airport lies just a few feet above sea level with all the past of Callao. Cargo building will serve as temporary passenger building until new terminal is completed next year. Jet traffic approaches the airport from the sea, eliminating noise problem. Runways are equipped with U.S. and Soviet landing aids.



Main runway is 11,000 ft. long 147 ft. wide. End on magnetic heading of 127.147 deg. Runway is equipped with helicopter nose-on to assist traffic flow. Also 15,595 ft. of runway have been laid and single one a crash for construction of parallel strips.

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To learn how economically Hamilton Standard's specialized overhaul experience and facilities can aid your maintenance program, please or write: Manager, Overhaul & Repair Department.



HAMILTON STANDARD
DIVISION OF UNITED AIRCRAFT CORPORATION

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AIRLINE OBSERVER

►Vielco Aviation is continuing to hold engineering and performance parameters of the VC-11 turboprop stage (it's long) in a flexible state despite the fact that it has received an option for 15 of the aircraft from a South American airline. Vielco does not feel that the single option would justify forcing the design of the VC-11 around one customer's requirements. Also, since consideration is being given to designing the aircraft around U.S. local airbases rather than Rolls-Royce bypass engines as a means of attracting U.S. markets.

►Implementation of the first new B-15 service since the Dynkin turboprop transport was grounded last August because of fuel injection problems has been announced in the Soviet press. The new service is further evidence that the bulk of B-15 service has been restored. The current B-15 run is from Moscow to Krasnoyarsk in central Siberia, a 2,217 mi. route which will be flown daily on a 5 hr. 40 min. nonstop schedule.

►De Havilland Aircraft has expanded its efforts to sell the triple turboprop DH-121 Trident transport to U.S. carriers. A 10-man de Havilland sales team spent part of last week trying to transfer American Airlines' interest in Boeing 727 triple turboprop transport (AW Dec. 32 p. 46) to the Trident.

►Federal Aviation Agency has ordered nine additional language retrain from Raytheon Co. at a cost of \$3.2 million. This will bring the agency's total of long range retrain facilities to 52. Use of equipment on the new equipment gives the retrain a range of 200 mi. and up to 60,000 ft. altitude capability as theater ranges.

►Trans World Airlines is considering showing first non-stop routes in long-haul international and overseas markets flights. Custom-designed projects, the Trans-Canada developed by David F. Moore of Inglethorpe Marine Park, Inc., is completed in a cruise component at the rear of the fuselage cabin and the screen is placed in front of the compartment behind the lounge. For use with individual volume control over the sound to the passengers. One unit has already been installed in a Boeing 707 for evaluation.

►Federal Aviation Agency has forecast an increase in the number of passengers carried by the three U.S. certified helicopter carriers from 356,000 in 1999 to more than 2 million by 1972. The FAA also has evaluated requirements for helicopter services in metropolitan areas other than New York, Chicago and Los Angeles, where services have already been established. Washington, D.C., and San Francisco-Oakland stand out as likely possibilities for continued operations in the next decade, according to FAA.

►Continental Airlines has been authorized by the Federal Aviation Agency to increase time between overflights on its Pratt & Whitney JT3D turboprop engines from 200 hr. to a total of 1,600 hr.

►Recent audit through in-flight checks was triggered in part by several large orders to buy American Airlines, including one by a major insurance trust. The carrying move by the group probably was encouraged by Civil Aviation Board reconfirmation of the 15,550 hrs. of aircraft of American, but reduced market factors also played a role. One source pointed out that the year-end only order was not quite certain to push up prices of dependent airline stocks into January but without any fundamental improvement in business in sight, he said prices are apt to fall back quickly, especially since general economic conditions show little sign of supporting a general, sustained market rally.

►West Indian Civil Aviation Commission recommendation for a West Indies national airline might mean liquidation of British West Indies Airways and formation of a new company. British Overseas Airways Corp., which owns BWA, now could only be permitted to hold a majority share in the West Indies airline. The Commission recommended a small jet fleet—50 engines of five aircraft—for the proposed airline, with short-medium range service in the Boeing 727, Vielco VC-11 or the DH-121 based on suitable.

SHORTLINES

►British Overseas Airways Corp. has been recommended by a Civil Aviation Board committee for authority to serve Philadelphia, Baltimore and Washington in additional conventional points with New York on its transatlantic route. Eastman also recommended that Boston, now classified as an intermediate point, be refueled as a conventional point.

►De Havilland Aircraft Co., Ltd., has delivered the last of three Comet 4C turboprop ordered by Compañia Mexicana de Aviación. To date, de Havilland has delivered six of its earlier 60 Comet 4-4B or 4C aircraft to eight airlines, the Royal Air Force and the Royal Canadian Air Force.

►Eastern Air Lines has started daily round trip Douglas DC-6B turboprop service between New York's Kennedy Airport and John F. Kennedy International Airport, Fla., beginning in the middle of daily turboprop flights operated by Eastern to Florida from New York.

►El Al Israel Airlines plans to begin operating weekly Boeing 707-420 turboprop service from New York to Tel Aviv Jan. 5. Aircraft will be leased from Vanguard Airlines until the first of El Al's 707s are delivered next spring.

►International Civil Aviation Organization has three new African members. Beginning with membership in 1968, the three newest are Republics of Mali, Senegal and Federation of Nigeria.

►Northwest Airlines reports traffic in November was off 37.6% from the same month last year and attributes the decline to the strike by DC-8 flight engineers. All Northwest's DC-8s are grounded.

►Pan American World Airways plans to begin twice weekly turboprop service from New York to African points Jan. 5. Operating with both Douglas DC-3 and Boeing 707 turboprops, the flights will leave New York on Tuesday (to Dakar, Mombasa, Accra, Leopoldville and Johannesburg), on Saturday, a flight will originate in New York for South Africa, Accra, Lagos, Dakar, Mombasa and Accra.

►Probus Airlines plans to substitute a seven-day-a-week family plus service for a 4-day-a-week service. Under the plan, one parent, two or three children and the other adult and all children under 12 pay two-thirds fare.



this new turbocopter delivers a 2,000-pound payload at 14,000 feet



Sikorsky S-62 demonstrates 2,000 pound payload capacity in the Sikorsky at 14,000-foot altitude

The Sikorsky S-62 can hover....and then deliver, with pin-point precision, a 2,000-pound payload at 14,000 feet. This far exceeds the performance of helicopters of the S-62's weight class, and actually betters the performance of much larger helicopters. The turbo-powered S-62 thus opens new horizons for high altitude exploration, construction and supply—major news for helicopter operators. Altitude capabilities are only one of the many

unique features built into this boat-tailed turbocopter. It takes off and lands almost anywhere—land, water, shipboard, marsh, tundra, ice, road. Find out more about the S-62's economies and operating features. Call or write Sikorsky today.

A New World of Mobility by
SIKORSKY AIRCRAFT
Spartan, Connecticut, A Division of United Aircraft Corporation

A black and white photograph of two identical, highly decorative alarm clocks. They are designed in an Art Deco style, featuring multiple clock faces, ornate metal casings with geometric patterns, and several small bells or chimes at the top. The clocks are positioned side-by-side on a dark surface.

blows was driven by high pressure steam. The 1954 to 1955.

Disputes Cloud Nuclear Plane Effort in

Critical Period

Convair Air Force plans call for the first nuclear-powered flight of a subsonic experimental aircraft in 1965. This turbojet aircraft, weighing about 900,000 lb., will be built by Convair.

• **Pump & Whitney indirect cycle nuclear turbojet** in which the reactor is placed in the tail of the engine. The conventional chemical combustion

First development work with the student engine concept concentrated on the use of pressurized water as the heat transfer fluid. It began in 1952 and was abandoned as unattractive in 1953. A troubling fuel reactor was experimented with from 1953 to 1956 for use in the aircraft nuclear engine concept. When Soviet fuel reactors

posed unsatisfactory for aircraft use but has shown considerable promise for stationary ground power stations. Current interest with engine test benches



POOLED Installation of indirect cycle nuclear turbojets in a completely self-contained power package has been proposed by Pratt & Whitney. The pooled unit shown in a conceptual model above has two turbojets which operate from a single reactor.

Chronology of Nuclear Program Reorientations

- **1946.** Air Force began funding the Nuclear Energy Program for Aircraft (NEPA) program, which was to demonstrate the feasibility of nuclear-powered aircraft flight. Pratt & Whitney and Airpower Corp. was the program manager.
- **1946.** Atomic Energy Commission established the Lexington Project at the Massachusetts Institute of Technology with the same emphasis as the NEPA program.
- **1950.** Lexington Project and the NEPA program both concluded that nuclear-powered aircraft flight was possible, even though it would be difficult and expensive to achieve. Most of the constraints on these two programs centered on the estimate that it would take 15 years and over \$1 billion to accomplish the projected nuclear flight.

Air Force and Atomic Energy Commission placed out the NEPA program and the Lexington Project in 1950 and jointly formed the Atomic Nuclear Propulsion program. Objective of this program was to develop the technology of reactor materials, shielding and powerplant and aircraft design to the point where feasibility could be established on a detailed and firm basis. It was believed that this technology could be developed within five years if the problems were treated with maximum effort.

The ANP takes a total, integrated approach. The main shapes must be a member of the AEC representative to satisfy the low cost of U.S. reactor and should develop the nuclear reactor to develop the aircraft. He must also be a member of the Air Force to develop USAF responsibility for developing aircraft, engine and auxiliary systems needed for flight.

Rep. Gen. Irving L. Breck, who is in charge of the ANP program, is assistant director of the AEC's Division of Reactor Development for Aircraft Reactors and holds the Air Force position of Chief of the Atomic Nuclear Propulsion Office and Assistant Deputy Chief of Staff Development for Nuclear Systems. Gen. French replaced Maj. Gen. Donald J. Ryan in that post in 1979. Gen. Ryan had been in charge of the ANP program since 1973.

Technical management of the program is coordinated from the ANP office at AEC headquarters in Germantown, MD. Personnel of the office include Air Force, Navy and AEC personnel who ensure Gen. Ryan's authority over both AEC and Air Force portions of the program. From the contracting standpoint, the AEC handles the reactor and shield development, and other portions are funded by the Air Force.

The ANP office has experience over the nuclear aircraft. Pratt & Whitney and SAMP nuclear auxiliary power program authority over the nuclear aircraft program was transferred from the ANP office last October to a new AEC-NASA-Air Force-Air Force-Air Force office under the name of the Nuclear Energy Research Administration.

- **1951.** Objective of the ANP program was expanded to include the demonstration of nuclear-powered flight. Development work began on two types of nuclear engine. General Electric obtained a contract to develop the direct cycle engine, and Pratt & Whitney contracted to develop the indirect cycle engine. Personnel were sent to the indirect cycle development to get the engine test in the engine which was already a large ducted fan about 171 in. in diameter and 67.6 ft long.

- **1952.** Decision was made to build a government nuclear engine suitable for flight engine, the General Electric, and the flight engine developed by 1956. Direct cycle was chosen for the engine, and General Electric gave an aircraft nuclear propulsion project development team and began work on the flight engine on a scale of \$100 million.

- **1953.** General Electric experimental flight test program with the B-36 was cancelled primarily at the insistence of Defense Secretary Charles E. Wilson. General Electric direct cycle develop-

ment work was continued through Air Force Secretary Harold Talbott's decision of additional funds to the project.

Pratt & Whitney work with the pressurized water indirect cycle engine was terminated because of the engine's poor growth potential. The company then began a close association with the Oak Ridge National Laboratory in the development of a sodium cycle, including fuel reactor for use with an indirect cycle nuclear turbo engine.

- **1954.** Air Force developed a strategic nuclear system reactor motor for the nuclear aircraft to reply to top level demands that experimental to justify principle flight were not worthwhile when they were performed with a sodium cycle, jet engine. The weapon system required, WS-171A, called for a subsonic cruise bomber with maximum dash capability. Chemically fueled turbos would have been needed to augment the nuclear engine and provide the total power requirement for supersonic flight.

- **1955.** Pratt & Whitney and General Electric were the weapon designer, and Lockheed and General Electric contractors.
- **1955.** Construction was split into two engine-airframe teams for the WS-171A program. General and GE were one team and Lockheed and Pratt & Whitney the other. Navy began nuclear auxiliary power engine studies during this period.

- **1956.** USAF awarded the WS-171A program. Development of the engine continued with no specific program plan.

- **1957.** Pratt & Whitney work with sodium fuel reactor was terminated, and a small effort continued on heat exchanger and auxiliary engine.

- **1958.** President Eisenhower advised Congress that there was no money in the nuclear aircraft program. He rejected an effort to continue the program and get a flying testbed into the air as soon as possible. The President's rejection continued his budget development program, about \$10 million a year, with no closed goal.

Several months later, the Air Force proposed another weapon system, the CAMAL, nuclear aircraft, to provide continuous low-altitude, mobile launching and low-level penetration capability. Part of the low-altitude development program funds were used to allow Pratt & Whitney to begin limited work on a solid fuel reactor for the indirect cycle engine, as well as to continue the materials and basic turbine experiments. General Electric's work with the direct cycle was also continued.

- **1959.** Congress gave the CAMAL authority and funding. Dr. R. W. Taylor, Director of Defense Research and Engineering, subsequently rejected the advanced CAMAL program. On this occasion, a military aircraft aircraft was capable of sustained supersonic flight and it was not clear to him that this could ever be achieved with the available reactor materials. Dr. Taylor found that the major effort of the ANP program he found in developing improved materials, and he vetoed a heavily experimental aircraft program as well as the CAMAL weapon system. Engine development program at General Electric and Pratt & Whitney was continued. Dr. Taylor did not question U.S. ability to produce a nuclear aircraft of the appropriate size and weight of the B-52 which could stay aloft continuously for almost five days.

- **1960.** Air Force met with plans to build one General WS-171A engine experimental aircraft powered aircraft, with first flight tentatively scheduled for 1965. It has been estimated that this can be accomplished within the contract budget of \$10 million per year set down by the Eisenhower Administration. Flight test data from these aircraft will be used to validate specifications for the reactor, engine, auxiliary engine and ground handling equipment required for nuclear weapon systems.

General Electric and Pratt & Whitney engine projects were continued.



MODEL. Of the Pratt & Whitney indirect cycle nuclear engine design intended for the once-planned USAF-WS-171A, nuclear bomber it shows above. The P&W turboshaft is mounted to a revolving fuel reactor which is the Mark used in the left foreground. Flowing arrangement is shown the engine that would have been considered. If a second reactor had been added to the system to improve reliability, the plumbing complexity would have been greatly increased because of the interconnections needed to allow either reactor to operate all of the engine. The engine system was under development from 1955 to 1957.

engine and its reactor have been under development for a long three years. Log and metal is being used as the fuel transfer duct, and the reactor has had critical mass of solid fissionable material.

Financial Problems

Total development costs approaching an estimated \$2 billion to bring the nuclear-powered aircraft to first flight have caused concern in Congress and the Pentagon, but they are only part of the financial story. These development costs are dwarfed when the discussion turns to operational analysis and the cost of building, maintaining and operating a fleet of nuclear aircraft. Depending on the original assumptions, the estimated costs for this operation ran to \$10 billion or more for about 100 aircraft.

Policy approach of the government during most of the 1950s made it inevitable that the discussion of large financial commitments turn immediately to quantitative analysis and cost effectiveness studies for operational weapons. The Administration report required the nuclear aircraft engine in a factually accurate power system which should be pursued simply because it held promise of maintaining a navy

types of flight by going ahead with range and endurance to transport as well as weapons.

The nuclear-powered aircraft has had to be pushed almost solely as a competitor of such large weapon systems as the ICBM and the Polaris submarine. The current Air Force program to fly an experimental aircraft in such a low altitude, and it is the first bank with this concept of fiscal conservatism since 1955.

One of the principal needs of this post office is to make the nuclear-powered aircraft quickly in a strategic weapon system without giving through an operational flight phase has been to divert and confuse the technical achievements of the ANP group. While this group has not been able to build its own engine flight test data in a sophisticated operational and engine against engine, it has succeeded in solving the basic problems of nuclear-powered flight.

No one from the President's scientific advisers doubts the fact that the reactor, engine, shielding and all auxiliary systems needed in a nuclear-powered aircraft can be built with the current state of the art. Both the direct cycle and indirect cycle nuclear engines are considered feasible

systems. Arguments over the nuclear aircraft have moved completely beyond technical feasibility and growth concern the feasibility of supersonic nuclear flight, the cost of their high speed so fast and whether they are worth the money.

Technical Record

In the shift of arguments against the nuclear aircraft and its costs, the technical record of the ANP group has been largely overlooked. There is little doubt that, in proving the feasibility of subsonic nuclear flight, it has solved a large number of some of the most difficult problems which have not faced the nuclear aircraft as the operational engine.

Significant achievements in this record are:

- Nuclear engine systems developed by the ANP group and its contractors at approximately 50 times better than a power-to-weight standard than the present in the submarine, USS Nautilus and early US Navy better than the system as the NS Savannah, a cargo and passenger ship.
- Competent technical authorities in the U.S. and England, who had access to the necessary information, agreed nearly three years ago that the ANP



... 13 basic types

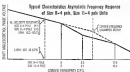
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group has assumed the power experimental period that a nuclear-powered aircraft could be flown.

■ **High temperature nuclear technology** in the U.S. has grown out of ANP work. The nuclear aircraft project was the first to develop completely as high temperature nuclear for aircraft, and through the ANP work, nuclear operating temperatures have risen from 450F in the Nucleonics to 1,600F in the most advanced experimental reactor for the direct cycle engine. This increase in temperature is seen the best hope for making nuclear electric power systems economically competitive with coal and oil systems in the near future.

Another hurdle weighing in favor of the ANP group is that it has been the victim of the bookkeeping system to a substantial degree. While there is no way to get around the fact that this type of developmental work is very expensive, the ANP program has been charged with expenditures which have done it little good but have paid off all in other areas of the overall aircraft engine program.

Value of By-Products

For example, \$85 million of ANP funds was spent on the circulating fuel, or molten salt, reactor development. While it is a substantial problem, power has been obtained for a flight system, but no one has an in-pertinent future technology. It would be difficult to use that that money was wasted, yet as the budget is now within all operating programs and amounts to about 10% of ANP spending to date.

The impact of high temperature nuclear studies in the U.S. here also has been charged to the program. This work was vital to the ANP effort, but it also drained much of the technical foundation for the River mouth reactor program. Photo nuclear neutron development and high temperature power systems for industrial use.

The management technique at putting the nuclear aircraft project in competition with other strategic systems to get its money and support has worked in a number of other cases, but changes and uncertainties in the program program goals. Considerable defense of the ANP program has developed because of these policy changes and uncertainties, which come from the highest levels in the Pentagon and the Administration.

From the program's beginning in 1946, progress was rather slow, with only 1953 the Defense Secretary Charles E. Wilson and others cancelled plans for an experimental flight test program being conducted by Convair and General Electric with a modified B-56. Since then, developments of both the reactor and engine well have been sustained and begun

again, and two different reactor-powered aircraft systems have been proposed and been abandoned.

Although a specific flight date has been set for a nuclear aircraft and a positive experimental schedule has been established, the possibility of a re-evaluation of the ANP program in the near future is as strong as it ever was. The new Kennedy Administration taking office in January could bring about changes in the ANP program's role of programs and its immediate objectives. If the new Administration feels that the current course is proper, there are still some uncertainties between which could lead to a significant program re-evaluation.

Current Controversies

The main controversy today revolves around the comparative desirability of the direct and indirect cycle engine systems and the size of the development budget. Consideration of the development effort on either the direct cycle or indirect cycle nuclear aircraft engine is being urged in various quarters to cut overall cost of the ANP program or to allow an acceleration within the current budget.

Some members of Congress, elements of Defense Department civil ion leadership, budget efforts in the Administration and certain groups within the Air Force and the other services believe that the ANP program could be described if one of the two competing engine systems were dropped and effort concentrated on the other.

On a purely technical basis, ANP program officials contend that it is impossible now to make a sound choice between the engine systems and that enough time has passed to suggest a sound decision probably can't be available for another couple of years. The sound choice then also requires the answer to two questions. These questions are:

■ **General picture of each engine** must be fairly established experimentally. Apparently most officials concerned to judge in the ANP program and in Dr. Yon's office now believe that the indirect cycle engine has the most growth potential and will make the most efficient nuclear powerplant for aerospace as well as submarine flight. This opinion is based largely on theory, and it will be at least two years before much solid proof will be available to substantiate it.

■ **Time required to bring the two engines to flight status** is not the most. The time each engine system has been considered for the direct cycle engine, which will require only slight modifications to be capable of flight and the next major development work at a complete engine prototype. It is estimated to be in about two years. The first engine experiment for the indirect indirect cycle engine design will not be

conducted for more than two years, and the first full system test is not due until the middle of 1964 under the present schedule.

It now appears that the indirect cycle engine could be flown two years in advance of the direct cycle engine. This time factor could be a major consideration if even in the U.S. is about to make the nuclear-powered aircraft project into an urgent, high priority program.

Disseminating Views

While the supporters of nuclear engine designs and managers apparently agree with these views, there is a large variation in opinion. But many disagree. It is not difficult to find people in the field who believe that the direct cycle has as much promise for a superior engine as the indirect cycle. Others argue that the indirect cycle engine could be developed much more quickly than the present schedule calls for and that if maximum effort were applied, an operational engine could be ready in about half the time now projected.

It is not possible to completely ignore three concepts because on many points they are based on substantial technical evidence. Unfortunately, there is an angle way to seriously consider these disagreements. The great potentialities of nuclear power for aircraft as indicated in some contracts involve technical operations. Although the ANP program has been active for more than 10 years, only a few have regarded their training have spent enough time with these questions to be critically competent to answer them. Close study surrounding the program has prevented an understanding of ANP problems in the military services or among serious and aircraft engine manufacturers.

If opponents of the dual engine development program are proved and one of the two engines must be cancelled in the near future, there is change of the ANP program and technical efforts of the AEC and the Department of Defense will be faced with organizing and controversial decisions. The disagreement over the technical merits of the direct and indirect cycle engines involves not only the controversy. This central through the Air Force and AEC personnel managing the ANP program and into top Defense and Air Force management.

The factor that causes greatest concern, however, is that the decision whether to cancel or not to cancel one of these engine systems is the next factor probably in the most important area to be made (concerning the nuclear-powered aircraft) in the next decade. Following that, the next most important decision would be which engine to drop.

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Satellite Size Limits Bio-Astronautics Data

rotation and transmitting or recording
programs)

In contrast, many of the U. S. experiments performed in bioastronautics or in space not shown much more than the feasibility of such experiments. Even the future availability of man-carrying Mercury space capsules will not add much to available data, because there is very little physiological instrumentation planned for the astronauts themselves.

What we'd really like to get is animal equivalents for physiological and psychological measurements of response to the environment," said Dr. Albert Hufnagel of USAF's Aerospace and Development Command. These include electroencephalogram data, blood pressure, body temperature, the transmissivity from muscle activity, such as the postural-support mechanism, and photography of eye movements to detect disorientation.

Psychological data would come from an operator task, where the neural learns to do something because of the reward it will get for performance. These data would be supplemented by real-time television transmission and on-board recording.

Contrast between Hetherington's stated goals and current Russian achievements was underscored by Sputnik V and VT bioassessments satellite experiments (AW Dec 12, p 25). Russian physiological test program apparently parallels that cited by Hetherington; physiological tests were not detailed by the Russians but certainly were included because of the emphasis by these countries on differences observed in the control behavior.

First steps toward Werhnington's set of goals include the development and experimentation with the Mk. 2 biomedical recovery capsule, currently in advanced design stage. This capsule, containing a single module, carries in-

transmission is sensitive to internal compartment pressure, temperature and relative humidity. The animals will be instrumented to produce an electrocardiograph and to record its respiratory rate, both for transmission by continuous telemonitoring.

A simple shock-exposure task such as ours will test the monkey's psychomotor facilities and will transmit results by automated telemetry. Other more complex tests will include acoustical noise level and frequency measurements as well as

ture. The animal's face will be photographed every three seconds to detect eye motion.

In addition to telemetry, recording equipment will be carried to store data during the entry phase when telemetry transmission is impossible through the ionosphere sheath.

Instrumentation took for several experiments can be used successfully as a result of work with surgically implanted sensors and transmitters which have proven the feasibility of telemetering data through intact animal skin. This work, done on two strains monkeys named Charlie Blaine and Lutz, was a joint project which was conducted by North American Aviation, Spacelabs, Inc., and Wyle Laboratories and was sponsored by USAF Ballistic Missile Division.

Ben L. Erickson of SpaceLab and a rocket flight test is scheduled for next year as a further step in the program. Current results from experiments made on a centrifuge, and on severe vibration means have paved the basic concept. But techniques of surgical attachment

Washington—A new theory to explain seismicity, if confirmed, will make it possible to use seismicity to determine the conditions of earth's magnetic and electric fields near the geomagnetic equatorial plane many thousands of miles out from the earth.

The theory, advanced at the American Rocket Society meeting by S. I. Auerbach of the Alaska Geophysical Institute and Sidney Chapman of the High Altitude Observatory in Colorado, seeks to explain why the aurora generally appears in the form of arcs or more long, thin bands of light in the northern hemisphere, usually at high latitudes and subsolar zenith angles. It says that small, isolated and tilted, while strong north-south currents usually appear around the earth in the southern region.

Alabado and Chagnon suggest that streams of protons and electrons arising from the sun, which are trapped by the earth's magnetic field, produce two earth's currents and magnetic fields that alter the earth's magnetic field and produce neural loss of magnetic field—which in turn produce the auras. The subsequent change in memory is believed to be due to the growth of an animal electric field and current along these neural lines.

Washington—NARA agreement that all specimens on loaned to institutions must be biologically sterile and the possibility that submersed propellant containing volatile organics could serve as a breeding base led to the establishment of a research program at Jet Propulsion Laboratory to investigate methods of sterilizing solid propellants.

Finally, IFT is evaluating the effects of a 24-hr heat shock at 17°C and early treatment of 10% emulsion. Early emulsions are that such treatment of solids affect the physical and ballistic properties of the solid propellant grain. Other stresses that might be involved, reported at the AES meeting by IFT's William Gao and Leonard R. Funke, are research to determine which solid propellant residues may already be inherently stable and exploitation of such to incorporate agents in the propellant formulation to kill bacteria.



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Aerojet Envisors Large Solid Boosters

Large high-energy, solid propellant boosters, with 7 million lb thrust weight, (booster weight) 180 ft long and 24 ft in diameter, according to the recently announced development by Aerojet-General Corp. (AW Dec. 12 p. 27) Aerojet is one of three firms conducting large solid booster feasibility studies under contract to National Aeronautics and Space Administration (NAS Sept. 19, p. 28). Multiple nozzle arrangement at ends in forming jet engines. Another, a large clustered solid motor on a possible thrust modification would be 180 ft long and such cluster would be 30 ft in diameter. Booster also would have gross initial weight of 7 million lb.

vehicle in time while remaining fixed in space, the nozzle plasma will be at constant level. In a positive displacement pump and provides a smooth pressure flow from one end of the pump line to the other. Unlike other types of pumps which tend to quit work at the end of the stroke pump, Gardner often runs right on the gas and provide positive power to the extremely low range. When, they are exceptionally responsive to the control signal.

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Power Produced With Dual Metal Sandwich

Washington—Production of electrical power by nuclear heating of a metallic and ceramic metal sandwich was demonstrated for the first time by an engineering team from the Westinghouse Electric Corp. at the 15th annual meeting of the American Nuclear Society last week.

The simple, rugged device could be developed to produce as high as one-fifth of a kilowatt-hour per pound of weight, according to G. G. Auer, of Westinghouse, who reported on the development.

The unit is made of an iron plate to which is bonded a layer of vitreous enamel. A third layer of silver metal is added on top of the enamel. With nuclear heating applied to the sheet—in the demonstration a commercial lithium isotope was used—production of electrical power began at about 2500° F.

High-temperature problems long considered for the unit and believed that metal-heating unit will be low. Some engineers think there is no use, however, and therefore no upper limit on the amount of producible power.

Possible applications include power production from the heat of rocket exhausts, or from aerodynamic heating during reentry. The concept is continuing basic and applied research in the field and expected to be able to make a complete technical report in about one year.

Range Radar May Locate Satellite Orbits

By George Alexander

Booths—Use of radar which returns side range has exact determination of satellite orbits—with a distinct space-based application to an advanced Scout (Satellite: Interceptor) program—was described last by Lt. Robert M. Baker, USAF, project officer in the Air Force Ballistic Missile Division's Space System Directorate.

In a report to the current Air Research and Development Command's seventh annual symposium and engineering symposium, Baker said that space-based techniques could be applied to "an advanced intercepter satellite" (passive) as advanced Scout, as well as the national space surveillance system and tracking of launch or deep space probes with numerous sensors, sensors and displays of operation.

Either pure range data, derived from a standard pulsed radar, or magnetic data derived from a Doppler radar, Baker said, would give the location in all satellite orbits.

► **Angular measurement**, which is the product of the satellite velocity, measured to its orbit at the place of its orbit, and the angle of the orbit of the orbit. Thus, the angular measurement of a satellite at its perigee of 900 mi with a velocity of approximately 14,000 ft/s is the same as the angle of 900 mi with a velocity of 14,000 ft/s.

► **"W" vector**, which is essentially the angle of inclination. This vector can be measured in the orbit of an object, a typical case with the measurement of the cone's base representing the orbit of the orbit. Distances from the apex of the cone to points on the base will vary, but the altitude will remain constant. This vector is perpendicular to the orbital plane of the orbit, as is a cone with vertex at the equatorial plane, and the angle formed between the two cones is identical to angle formed between the two planes.

An advanced Scout satellite, as the Scout equipped with a dual one-dimensional range radar, a lightweight digital computer and a memory unit, could track distances from two to ten miles in a satellite's orbit and could then perform its own tracking operation in space. With such a system, some orbital refraction would prevent problems at orbiting altitudes and frequencies could be selected that would eliminate atmospheric problems from ground-based stations.

The Scout program now under development by USAF calls for ground-based angular tracking of unknown satellites, with the information trans-

mitted to the Scout vehicle overhead.

With range radar, however, an advanced Scout might operate like "a gun." Detection of a satellite reveals a range separation of 150 mi. At one-second intervals, range approximately doubles, to 300 mi, 450 mi, 600 mi, 750 mi, 900 mi, 1050 mi, 1200 mi, 1350 mi, 1500 mi, etc. Knowing its own altitude and speed to be 400 mi and 28,000 ft/s, the advanced Scout's computer would rapidly figure that a vehicle giving these readings would accurately be tracking at a velocity of 23,100 ft/s, or an orbit 200 mi high and moving in an opposite direction.

Since a number of range radars will describe the range characteristics of the incoming cone, the computer would also determine the unknown satellite's "W" vector, at angle of inclination, providing the advanced Scout with all necessary information on the orbit's orbit.

The necessary unit would then search its memory of known orbits for a vehicle operating at that altitude and velocity and at that time and select position over the earth. If the observed parameters checked with those of an incoming cone, Spotted, or Tied, then the Scout would merely record the intercept and pass on it. However, the observed orbit characteristics did not check those of the orbit listed in the memory unit, the advanced Scout would immediately report an unknown, unidentified satellite in orbit and begin intercept and suspension procedures.

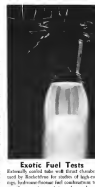
Because the advanced Scout would operate in conventional satellite, attitude stabilization and angular reference systems could be eliminated. With such two orbital characteristics in computer, the computer could be a relatively simple electronic digital unit as can presently under development. Not radar, as Baker said, it would be a Scout vehicle that is a continuous light, cheaper and being in an even more reliable satellite, as the present planned Scout program. The one disadvantage about an such an advanced Scout, Baker said, would be the large power supply required to run the advanced Scout's system for Nuclear Auxiliary Power, however, might be a minor one.

Range radar, Baker said, could also greatly simplify the task of the advanced Scout satellites, tracking left. An array and most satellites are placed in orbit within the next few weeks, the problem of tracking all vehicles, and identifying them, will be tremendously difficult and complex, if not almost impossible.

Although angular track radar can plot orbit within a degree of accuracy, Baker said, "look" angle, then plot characteristics of altitude and the right coordinates required between other angular trackers in the net do not hold as much promise in range and/or range-rate radar. Baker said that a system of about an high-precision display or polar radar could easily handle the masses of satellites and still be able to spot new or untracked vehicles at either high or low orbits, less than or deep probes.

Further, although Spotted, Tied, Tied, etc., could undoubtedly perform these tasks within fairly wide orbital tolerances, some future programs—such as one—will demand extremely accurate orbital measurements in order to carry out their missions.

Launch, interceptary and deepspace probes could also use the accuracy of range-rate tracking, Baker thinks. An advanced probe, possibly further from earth, an angle relative to its launch plane rises only slightly when compared with the past success in distance with time. Range radar could measure the distance of the probe and then in distance then angular tracking radar could distinguish slight variations in angles.



Exotic Fuel Tests

Extremely cold fuels with thrust chamber used by Rocketdyne for studies of high-speed hydrogen-fueled engines will be tested in a special test chamber.

NOW, TIROS II

New Television and Infra-Red Observational Satellite

TIROS II—Improved observational weather observation—delivers TIROS I to provide data with new and more comprehensive views of earth's ever changing weather patterns from its vantage point some 400 miles in space. The new, more delicate sensors and data pickup and return in earth-orbit provides a greater work for new giant strides in meteorology and long range weather forecasting.

TIROS II satellite, like TIROS I, was designed, developed and built by RCA's Astro-Electronic Division (for the National Aeronautics and Space Administration). It includes all of the equipment of TIROS I—TV camera, tape recorder, TV transmitter, command receiver, timing mechanisms, telemetry and telemetry support—plus many new and improved devices. Chief among these are:

New telemetry and command links for better system—designed by NBSI to measure and control the heat output on the earth and to detect and adjust new dimensions in orbiting for data.

New magnetic tape-recorder—provides additional data in the form of the earth's magnetic field on TIROS II and will be able to store information of the entire orbit on its magnetic portion of film.

New tape support system—its top-of-the-line system will be able to store data in the form of magnetic tape.

New improved TV camera—provides improved images in different parts and angles.

Improved thermal sensors and new angle camera—give better information on the most efficient use of satellite photo study and data.



Great advance: the TIROS II was designed and developed by RCA. This picture shows the entire system of the TIROS II, as it is, by the National Aeronautics and Space Administration. It is the first of the TIROS II and the first of the TIROS II.

Many of these outstanding improvements were designed, developed, tested and incorporated in TIROS II within the short period of time since TIROS I was launched. It is an example of the level of dynamic capability that is available as you use RCA's Space Center by simply contacting the Marketing Manager, RCA Astro-Electronic Division, Princeton, N. J.

If you are interested in participating in this challenging new effort, contact the Employment Manager, Astro-Electronic Division, Defense Electronics Products, Princeton, New Jersey.



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Hollow Fibers Cut Space Vehicle Weight

By Michael Yaffe

Washington—Substitution of hollow glass fibers for the conventional glass fibers used in reinforced plastics proves an significant weight reduction in structural elements of aerospace vehicles.

In a structure under compression, composite materials made with these new hollow fibers, which are now available in non-production quantities, is offset by a four-fold increase in strength at no increase in density.

These new low density materials are also expected to have a significantly lower dielectric constant and electrical loss factor, giving them an important advantage in radome structures, according to Irving J. Gussow and Morris F. Dow, consulting engineers in General Electric's Missile and Space Vehicle Department.

Work on the hollow fiber materials was carried out by General Electric under a contract from the Air Force Ballistic Missile Division. It was one of several new developments in materials and structures discussed at the recent annual meeting of the American Rocket Society.

Another report concerned a family of trapezoid beam composites developed by Aero-Corp's Research and Advanced Development Division for the use in rocket nozzles. These materials, trade-named Avconat, are capable of operation in exhaust gas temperatures above 6,700°; almost 600 deg above the service limit of pure tungsten, according to Arthur S. R. Mohr.

Believe rocket nozzle made from Avconat—the best of the tungsten-bone composites developed to date, have been successfully fired for 90 sec on solid propellant rocket motor firing alignment propellant at 1,000 psi.

Full scale nozzle inserts and blast tubes for the Minuteman second stage

made of Avconat will be evaluated shortly by Space Technology Laboratories. In addition to its greater non-oxidation resistance, the tungsten composite is stronger and more ductile than pure tungsten, and therefore longer during machining and assembly is significantly reduced. Also, the composite material can be fabricated with standard ceramic cutting tools and techniques without the need for grinding.

Along the same lines, the Avconat Division of Dayton Ford Co. has developed a polymeric composite material for solid propellant rocket nozzles. Nozzles made from this material have been successfully fired on motor using an aluminum polycarbonate solid propellant that is believed to be similar to the propellant developed by Aerojet General for the Polaris.

The article developed by A. V. Levy and H. Lippert of Hughes and S. M. Loefer of Aerojet, states that a thin tungsten sheet metal liner that is bonded to the nozzle casing and then forced to a graphite backup structure after burning, multibeamers were stamped around the graphite and an insulating liner made from phenolic plastic reinforced with ceramic fibers is integrally molded around the nozzle and placed in a steel outer shell to complete the assembly of the nozzle.

To meet the requirements for a second-stage composite, the authors said that material should overcome the drawbacks of metal and should be present in a sufficiently large homogeneous mass to maintain its own structural properties. In the case of the Hughes rocket nozzle, the tungsten liner acts as the erosion barrier while the graphite heat sink backup provides light weight. The multibeamer star wrapping is used to keep the graphite in contact with the tungsten liner and to protect the steel shell which carries the hoop stresses.

Nathan Research Corp., another supplier working on the development of high temperature materials for solid rocket solid propellant rocket motor nozzles is approaching the problem through alloy rather than composite materials. This group is particularly interested in high modulus, low temperature alloys which are to be significantly more ductile and easier to fabricate than tungsten. NEC is currently carrying out development work on a 90% molybdenum-10% tungsten alloy under Navy contract.

Currently, Aerojet is believed to be using pure tungsten inserts in graphite

backup blocks for the nozzles in its Polaris motor. But with the Navy looking to an advanced 3,000 psi motor and beyond, there has been growing interest in developing lightweight rocket nozzles capable of withstanding significantly higher combustion temperatures for prolonged burning times.

Some rocket engineers don't feel that the oxide atmosphere of these advanced solid propellant motors can ever be stable through materials development alone. Avconat Wrote has found that three composite structures using a temperature cycling system for nozzles exploring double wall construction and a high weight and low melting point metal such as sodium or lithium. The low melting point metal, which would be covered between the walls of the nozzle, would cool off through porous walls absorbing enough heat as the process to keep nozzle temperature well within the operating limit of the nozzle. The composite system before that a cooling system such as this would add two to three weight penalty.

In their paper on composite mechanical systems, Levy, Lippert and Loefer discussed several advances made in ceramic reinforced with refractory metal fibers. One of these was the metal reinforcement observed in the thermal cycling and shock behavior of these by incorporating 30% by weight of multibeamer fibers, 0.01 in diameter and 125 in long. Somewhat along the same lines, they talked about a multibeamer fiber fabric impregnated with a resins that they discussed.

ARS Elects Officers

Washington—Harold W. Enckley, vice president and technical director of rocket operations for Throckmorton Corp., was elected president of the American Rocket Society, according to Howard S. Strick.

William H. Eckert, director of the Jet Propulsion Laboratory, was elected vice president. ARS Fellow Member Robert W. Gossard, Jr., was elected president. Other officers elected were: Group D, G. Gossard, Thomas F. Gossard, A. J. Riggs, Jr., Bernard H. Dorn, Willy H. Koenig, W. D. Koenig and Mortimer Rosenberg.

Thomas Van Korman announced that this year's Robert H. Goddard Memorial Award, the Society's top honor, ARS President Arnold for 1968 went to Ernest Seiberg, the James H. Wild Memorial Award to Robert E. Johnson, and the G. Edward Smith Award to Luigi Coenen. Scott Confield received the ARS Achievement Award.

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A balanced engineering and research program is now being formulated to advance the state of the art.

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Mr. Lee is now staffing key positions in Astropower, Inc. and will welcome inquiries from qualified engineers and scientists having advanced degrees in the areas of reactor physics, plasma physics, solid state physics, thermodynamic and high temperature materials.

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ent to better than 97% of theoretical density.

This monolithic fiber-reinforced composite (70% by weight carbon-fiber) was exposed to flame temperatures of 4,500° and then water quenched by hot water with no apparent damage, silica showing a marked improvement over standard resins in thermal shock resistance.

The authors also discussed experimental composite structures made from several different carbon reinforced with tungsten fibers. Tested in a rocket motor firing a nozzle made from hot plasma, tungsten-reinforced systems made showed excellent thermal shock resistance and no apparent erosion, according to the authors.

At the same time it was found that these carbon, boron carbide and boron nitride could react with hydrogen to produce brittle networks of hydrogen chloride, etc. thereby eliminating these carbides as base materials for engines on hydrogen fuel.

Another promising development in part was Airway Research Foundation's technique for attaching a rocket nozzle throat to a nozzle reinforced with tungsten fibers. Essentially a felt-like infusible, it involves first shaping

Car Satellite

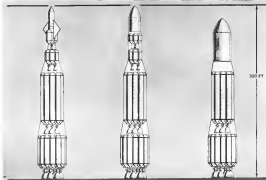
Washington-Air Force is developing high-gas pressure sensors using radio frequency lines mounted over optical fibers for possible use in private communications satellites. (AFW 50-215, p. 56). Progress is part of USAF Project Car (previously "Carver"), an acronym for Communication Satellites Applied Research.

Initial tests of the high-gas sensors, expected to provide a 100 to 1 increase in reflected signal strength over the Edo 8 type optical reflector, will be made with a high altitude balloon using a 10 ft. diameter model. USAF is covering passive communication satellites with increased interest because of their low cost, wide availability, extreme reliability and operational flexibility compared with active radio communication satellites.

The fibers, 50 ft. in diameter, into the rocket configuration. The shaped fiber structure is then placed in a porous mold, and an opaque heat stop of the ceramic material is vacuum filtered through the carbon. After drying, the opaque is then heat pressed and material is a carbon cloth at 4,000 psi

As extension of the work in fiber-reinforced composites in the wall under way is about as soon as possible composites in which the ceramic is bonded to the metal instead of being impregnated in the metal fiber by means of a liquid slurry. As a result of this work, the authors said, large composite systems have been produced for use in insulating coatings and structural elements that operate extremely promising for cyclic service at temperatures up to 4,500°.

One particular material mentioned by the authors consists of a stainless steel reinforced ship used to reinforce aluminum phosphor bonded alumina. The material, they said, has been used successfully as a coating in rocket core burner chambers 8 ft. long and up to several feet in diameter. With modifications was easily protected with a peak concentration coating substituted for the impregnated steel strip, the material also has been used in structural applications such as wing leading edges which have successfully withstood several 20,000 cycles of exposure to temperatures of 3,500°. Use of these materials can be extended to higher temperatures by going to ceramics such as silicon, according to the authors.



Rocketdyne F-1 Rocket Engines in Clustered Configuration

F-1 rocket engine, producing 1.5 million lb. thrust, is under development by Rocketdyne Division of North American Aviation, Inc. The engine, expected to be ready for schedule only in 1968, may be adapted to provide launching thrusts from one to 12 million lb. Engines will make possible a launching vehicle able to reach 200 tons, use low cost and placing 45 ton space vehicles in orbit about Mars.



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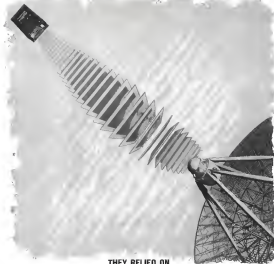
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THEY RELIED ON RADIATION TO TRANSMIT AND RECEIVE TIROS' WEATHER DATA

Now that the performance record is complete, it can be reported factually. All closed-circuit pictures were transmitted to earth by two Radiation Model 3815 FM telemetry Transmitters. Over 90% of the pictures from NASA's *Tiros I* were received as Radiation telemetry. Both the transmitters and the antennas have proved their reliability in several major missile programs.

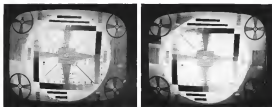
The two automatic tracking antennas which covered the weather pictures are located at Ft. Monmouth, N. J., and Kauai Point, Hawaii. Radiation designed and built the Kauai Point antenna, converted the one at Ft. Monmouth to automatic tracking. During the 1600 orbits completed by *Tiros I* in 3½ months, peak-to-peak antenna operation gave automatic satellite acquisition and tracking.

Transmitters and antennas... electronic data acquisition and processing systems... radar... instrumentation... all these are areas in which Radiation's capabilities have eminently aided the defense program. Industry and the advancement of electronic technology. For a closer look at the things we do... and can do... write for our "Capabilities Report". Radiation Incorporated, Dept. AW-12, Melbourne, Florida.



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AVIONICS



TWO television test pattern pictures (picture shows ultraviolet radiation and quality of ultraviolet communications video. Picture at left was made from TV monitor fed directly by TV camera, while photo at right was transmitted over ultraviolet beam before being displayed.

Ultraviolet Tested for Communications

By Philip J. Klein

Radiofree-space techniques for a space communications system that operates in the ultraviolet spectrum, giving it many important advantages and also, frequently for space vehicles have been developed here by Westinghouse Electric's Air Arm Division.

Westinghouse tests and calculations indicate that an ultraviolet continuous-circuit system can provide narrow-band communications rate channels of 20 million cps with a radiated power of only a few watts. Using radio frequencies, the radiated power would have to be 500 watts higher, at least.

Ultraviolet communications also appear attractive as a means of transferring messages directly between communications satellites in synchronous orbit, such as the Navy's Project Nike, without using an earth-based station as a relay.

Used UV

Because the earth's ozone layer and atmosphere absorb and attenuate ultraviolet (UV) radiation heavily, it appears likely that this portion of the spectrum will be limited in use as a space. However, a combination of radio and ultraviolet could be employed for communications with homing space vehicles using an earth satellite which would convert radio signals from an earth-based station into ultraviolet for relaying to the space vehicle, and vice versa.

That is the proposed ultraviolet communication system which Westinghouse calls Ultraviolet, a hybrid satellite technique which has been developed for generating a very small and cu-

tureless atomic spectrum of narrow-band ultraviolet (UV) radiation which can be amplified-modulated easily.

Briefly, the UV generator consists of a neon-filled cathode-ray tube whose face is coated with a P16 phosphor that produces ultraviolet radiation when excited by an electron beam. Using a standard 52P16 tube, Air Arm

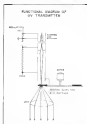
scientists have produced one watt of ultraviolet radiation from a spot only 6.651 in. diameter, according to Dr. Paul Fan, who heads Air Arm's applied physics group. Fan is confident that selected power can be increased to 20 watts without increasing spot size, and hence selected beamwidth. It is a tube specially designed for this application.

Ultraviolet Advantages

The ultraviolet region of the electromagnetic spectrum offers several attractive features for space communications that the radio portion of the spectrum lacks. Most of these stem from the fact that UV has a frequency that is at least one million times that of the radio bands normally used for space communications.

Because the beamwidth of radiated energy is proportional to frequency, ultraviolet permits much increased energy concentration. This means that longer communication ranges can be obtained with the less power and with much smaller antennas/receivers than at radio frequencies. Both are important considerations for space vehicles where electric power is at a premium and long antenna structures pose weight and mechanical design problems.

The narrow beamwidth, which can be a true feature of a direct using medium size optics on the UV transmitter, offers another attractive advantage, particularly for military use. These are communications channels and equipment located from man-made and certain types of natural satellites. An ultraviolet communication receiver should be quite visible could be detected if aimed directly at the sun, as would an optical or infrared



HEART of the new video is the ultraviolet transmitter which produces high-resolution spot sizes of ultraviolet radiation. This video resembles conventional video-ray tube, except that a very short-persistence phosphor that produces ultraviolet is used. To increase intensity of radiation without heating out the phosphor, it can be placed on a rotating disk. Signal is reproduced on ultraviolet beam by amplitude modulation of the electron beam intensity.

continuous system. But the nucleus beamwidth and absence of side lobes will enable the reactor to "lock" in the vicinity of the use without being accompanied by side radiation.

Because the ultraviolet region covers a band of more than 1,000 m μ , it offers extremely wideband capabilities, up to about 10 m μ , limited only by the available transmitter power. In a demonstration for American White, using an experimental setup with a radiated power of about one watt, Air Force scientists transmitted both television and voice simultaneously over a distance of about 10 ft using an ultraviolet beam. Beam was amplitude-modulated by varying the intensity of the electron beam.

Another virtue of ultraviolet communication for space, whose reliability is so important, is the comprehensive availability of the required equipment.

Ultraviolet Generator

To engineers accustomed to the long-persistent type phosphors used to excite air tubes for radar applications, the concept of transmitting ultraviolet information by varying cathode ray tube spot brightness might seem questionable at first glance. However, the brightness level of commercially available P16 phosphor drops to one tenth of its peak value within 0.1 microsecond after excitation is removed. Other available phosphors have even shorter persistence times.

The principal problem in using a cathode ray tube as an ultraviolet generator is to devise techniques which will permit usable levels of ultraviolet energy to be generated in a time span without overheating and destroying the phosphor.

The P16 phosphor used at Westinghouse has a conversion efficiency of about 33%, according to Joe W. Ogilvie, one of Dr. Pan's associates in the signal-physics group. This means that 30 watts of electron beam energy impinging on a small spot of phosphor on the CRT face are required to produce one watt of ultraviolet radiation. In using a direct electron phosphor material, Ogilvie says it should be possible to increase conversion efficiency to around 40%. This would increase electron power density by a factor of four.

But further increases in ultraviolet radiation level require higher electron beam currents, and this will overheat the phosphor, causing burn out of that spot on the CRT face.

One way to increase electron beam energy level without damage to the phosphor, and without increasing size of the UV radiation source is to place, inside the CRT about its long-stem end, while maintaining the



ULTRAVIOLET communication system, developed by Westinghouse Electric for use by space vehicles and communication satellites, is demonstrated in laboratory. Television camera (1) aimed to subject produce signal and to modulate reflect by tube (2) which produces narrow beam of ultraviolet electron ray (visible in picture). Ultraviolet beam is directed at phosphor (3), which converts modulated ultraviolet into video signal delivered to TV monitor (4).

electron beam deflection yoke fixed. This is an adaptation of a technique used in X-ray tubes.

The arrangement keeps the electron beam and the modulated ultraviolet fixed in space while the phosphor-coated CRT face is continuously rotating and changing spot phosphor area under beam excitation and opening hot areas over for a cool-down period.

One of several other possible techniques for accomplishing the same objective characterizes rotation of the CRT by placing a rotating mirror, at a 45 deg. angle, directly over the tube's face. In this case, the electron beam rotates around the CRT face in a continuous scan with the rotating mirror which is assumed to flat the electron spot area so that the electron spot appears to be fixed at the focal point of a parabola in focus.

A means of providing additional cooling for the phosphor, under consideration by Westinghouse scientists, is to deposit phosphor on a metal substrate which can provide conduction cooling.

The ultraviolet radiation is then obtained by reflection through the glass walls of the tube instead of through a face.

In means of these, and possibly other, techniques, Ogilvie believes it should be possible to obtain as much as 20 watts of UV radiation power.

At the receiving end of a communication system, radio has a slight edge over ultraviolet because all of the energy available in the radio signal can be used whereas the photon energy available in ultraviolet must first be converted into electricity and the efficiency of available energy is less, approximately 20%.

Westinghouse scientists show that power received must be about 60 times higher for ultraviolet than for a radio signal for the same signal-to-noise ratio. However, this is more than compensated for by the greatly increased energy concentration possible at ultraviolet frequencies, previously described.

Dr. Pan reports that Westinghouse scientists are working on a promising



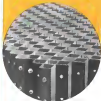
Electronic modules, enclosed in the Bendix "hot banjo" test chamber, are subjected to fast neutron and gamma radiation produced by the University of Michigan nuclear reactor.

HOT BANJO Anticipating the need for space and weapon system electronics to operate in a severe radiation environment, Bendix is developing equipment that resists both transient and cumulative degradation, or activation. To experimentally simulate this environment, electronic modules in a "hot banjo" test chamber are placed next to a fission plate which is inserted in the core of a 1 Mw reactor to triple the fast neutron flux. Such Bendix research is providing the keys to advanced system development. Positions are available to better engineers and scientists.

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TWO possible solutions to the problem of obtaining electron beam energy for the ultraviolet transmitter are shown. Top view shows cathode on tube which is heated by drive anode, while an electron beam is formed by electron electron beam in feed portion. Bottom view shows a rotating anode which spins in synchronism with rotating beam of CRT, creating energy making ultraviolet beam appear to come from center anode and rotate beam.



new source for conversion of ultraviolet photon energy into electricity. It is expected to be considerably more sensitive than vacuum tube anodes.

The company is not yet ready to disclose details on the new source, but its work in multi-stage photoelectric tubes with extremely high sensitivity in the visible light region suggests that new UV source might employ similar principles.

An additional problem is that a sensor's frequency sensitivity must be fairly closely matched to the spectrum emitted by the CRT processor to make maximum use of the energy spectrum generated by the ultraviolet transmitter and to minimize noise due to reflections from other sources. The cath is not a broadband source of noise to an ultraviolet communication system, as it would be in a system operating in the infrared region. Optical points out, however, the work's status shows across as an effective shield for UV schemes.

Tests and analyzer conducted to date indicate that a semiconductor ultraviolet transmitter and receiver, and associated power supply, could be built for a total weight of less than 30 lb., including a 3-ft-dia. antenna/collector. Total

volume, excluding antenna/collector, would be less than one cubic foot.

Based on the one-watt electrical power level already achieved, Westinghouse scientists believe the system could transmit a 16-cm bandwidth over a distance of about 15 million mi., or switched video signals over distances of about 500,000 mi. This would permit television transmission by ultraviolet from that moon to an earth satellite for video relay to the earth.

With the 201 anode as power source which frequency sensitive, however they can achieve, using techniques described earlier, the range of the system could be increased by 100%.

To date the ultraviolet communication program has been moved on with Westinghouse. Finally, recently, the company made available proposals to Wright Air Development Division, Army Signal Corps and the National Aeronautics and Space Administration in an effort to obtain contract funding to expand the program. With the funds, company proposes to investigate best transfer problems, tube configurations details and improved phosphors.

Under the program, company scientists would conduct ultraviolet transmission tests over longer distances in an effort to corroborate the range data now available on atmospheric transmission of ultraviolet. Dr. Pan says that there is a slim possibility that ultraviolet of the longer wavelengths was not suffer to reach atmosphere and might be useful for earth to satellite communication.

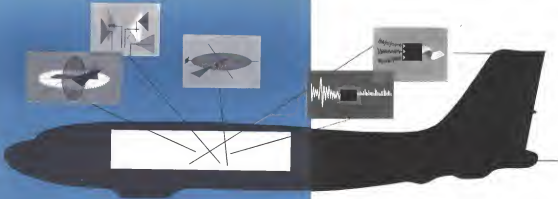
Westinghouse scientists also are "doing considerable thinking" on the subject of devising a means of general use coherent ultraviolet systems, Dr. Pan says. This would permit the use of frequency modulation instead of amplitude modulation, with the freedom advantages of FM over AM. If Dr. Pan and his associates have more ideas on how this might be accomplished, they are tight lipped on the subject.

The recent development of the optical maser, which produces coherent radiation in the visible and infrared portions of the spectrum (AW Enr 34, p 77), suggests that such a device might provide a source of coherent ultraviolet for space communications.



Cornell Develops Tracking Antenna

Peak power of 10 megawatts will be transmitted from this 5-ft-dia. diameter antenna by Frank Annunzio Laboratory scientists in experiments intended to improve ballistic missile and satellite detection and tracking. Program is sponsored by Advanced Research Projects Agency under Army representation. Antenna was built by EG&G, Inc., Waltham, N. H.



LING- TEMCO

ON THE

AN/USD-7

TEAM

Temco's Overhaul & Aerosystems Division was a natural choice as one of the seven outstanding companies selected to work on the AN/USD-7 project because of its systems integration, installation and flight testing capabilities. Temco provides these specialized airframe and aerosystems capabilities to the team headed by Airborne Instruments Laboratory, a division of Cutler-Hammer, Inc., prime contractor, charged with producing this electronics equipment for the U. S. Air Force. ■ Other team members are Aerojet-General Corporation, Filtron Company, Inc., Raytheon Manufacturing Company, Sperry Gyroscope Company and Sylvania Electric Products, Inc. Additional support on the AN/USD-7 program is provided by Temco's Electronics and Missiles & Aircraft Divisions. ■ Temco's Overhaul & Aerosystems Division also specializes in electronics systems development, from components to complete systems. It is a major maintenance depot for SAC's tanker fleet of KC-97s, and performs depot level maintenance and modification for several other Air Force organizations. Temco's complete capabilities include quick-turn-around maintenance to major engineering and manufacture for changing an aircraft's mission.



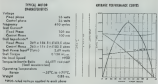
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maintained, lightweight side compensators and known in the AN/VRC 12 series. The Auto unit weighs 45 lb, less than existing models and has a 912 channel capacity instead of the 718 channels now available on tested equipment. The unit will consist of a radio-positioned instrumentation, an antenna receiver and operational accessories.

Northrop Co. has been awarded a \$2,150,000 contract to furnish 10 search in the Army's replacement Hawk missile.

General Precision Inc. has received a subcontract from IBM to expand current work on the AN/ASQ 28 doppler radar component for the B-70 bombing aircraft under program 100-100. The cost of the program through the prototype phase is expected to reach to several million dollars.

Sweden Associates, Natick, N. H., contract for the target-tracking system in the Navy Eagle as to its main, is transferring its work on the missile to the company's new Advanced System Laboratories in Burlington, Mass. The new facility which now occupies 15,000 sq ft, will be enlarged to 18,000 sq ft in the coming year and will eventually cover 100,000 sq ft and employ about 500 people.

Electro-Optical Systems Inc. has been awarded an \$84,450 contract by the Air Force for analysis aimed at simplifying the data search portion of intelligence analysis facilities, giving as also more time to interpret intelligence information. Electro-Optical will work on the acquisition and representation of intelligence needs, structures and concepts and then conclusions into a summary of the facts relevant to a stated request.

Ryan Aeronautical Co. has produced 231 units of land in San Diego from Magachon Corp. of America. Since 1975, Ryan has leased 134 acres of the land, including its electronic plant and two buildings which house its manufacturing facilities and its sales and engineering headquarters from Magachon. The additional seven acres of undeveloped land were bought by Ryan in several lots for the expansion of present floor space, which exceeds 100,000 ft, needs supplementing.

Martin Co., Orlando, Fla. will continue engineering and development of the Penning missile under \$3.5-million Army contract.

Goodrich Aircraft Corp., Lyndfield, Pa. will receive development and flight testing of the B-70 radar

data processor radar system from IBM Corp.'s Federal Systems Division. The contract resulted from the modification of the North American B-70 bomber program.

Alison Division of General Motors, Indianapolis, Ind., will continue production of the T-16 helicopter engine under \$59.5-million Air Materiel Command contract. Both T-16A-7 engines for the Navy, Coast Guard and Air Force Lockheed C-130B aircraft and T-16A-8 powerplants for the Navy's Grumman W-1B are included in the work.

Spery Gyroscopic Co. has been awarded two contracts by Air Force, totaling \$3.4 million for the production of navigation aids. Under the terms of a \$1.5-million contract, Spery will make remote attitude indicators which show the point such information as flight direction, pitch and roll. The other contract, for \$1.9 million, calls for production of flight direction computers which collect information from several sources and present it as the remote attitude indicator to inform the pilot of flight changes needed to stay on course. Spery has already delivered more than 600 of these units in the past two years.

Lockheed's Massachusetts Co. division has received a \$70,000 letter contract for development and flight evaluation

of the company-designed MADREC (Mathematical Detection and Reasoning) system which monitors the functioning of aircraft systems in flight. First installation of the system, which can monitor an system at one time and record the information on a oscilloscope graph, will be made on a C-130B B-52. Target date for the program completion is May 11, 1964.

Colson Radio Co. will deliver AGU 1-A and AGU-1A1 Horizontal Structure Indicators and amplifiers to Air Force under terms of a \$659,479 contract. Horizontal Structure Indicators are used in a plot with a plot view of an aircraft with reference to its navigation position.

Royal Canadian Navy transferred the first five of a total of 17 Taurus ASV aircraft to The Netherlands under terms of contract and to mission contract of NATO. The aircraft are built by the de Havilland Aircraft of Canada, Ltd., under license from Canadian Aircraft Engineering Corp.

General Electric Co. will continue production of the 20 mm. Valves are now under the terms of a \$2,000,000 contract awarded by the Army's Boston Ordnance District. The current agreement period funding for an order which eventually will call for 800 of the 4,000-psi-per-minute valves.



T64 to Be Tested in de Havilland Caribou

General Electric's T64 turboprop engine is shown in a nacelle of the de Havilland of Canada's DHC-4 Caribou engine nacelle. Two of the 2700-hp engines will be evaluated in flight tests starting next May. Each will get 20 hr. of ground operation followed by 400 hr. on the air. The low specific fuel consumption (0.61) turboprop has topped 4300 hp at testing at GE's Lynn, Mass., test site, will be a total of 3,800 hp, below its first flight.



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Experimental hydroskimmer vessel built, developed by Bell Aircraft Corp., sits above the water's surface on a cushion of air forced by a large fan located amidships. The research vehicle shown is propelled by a standard outboard motor.

Navy Evaluates Bell Hydroskimmer Research Vehicle



The large fan runs above drives on under the hull and holds it above the water, reflecting wave and forward drag. Hydroskimmer was recently delivered to the Navy for test and evaluation. It is 18 ft. long, has an 8-ft. beam and weighs 2,500 lb.



Artist's concept of a future naval attack vehicle utilizing the air cushion principle is shown at left. Artist's concept at right shows submarine carrying fuel and supplies from hydroskimmer. Vehicle would be capable of high speed with relatively low horsepower. Bell says.



READY FOR USAF

The Military Air Transport Service will get the new extended-range C-130E Hercules fast, because the basic design is already proved. The long-range Hercules goes into production at once to meet the immediate need for a modern strategic airlift force.

The new long-range version of the versatile Lockheed C-130 Hercules gives the Air Force a strategic airlifter that can carry a 20,000 pound payload for more than 4,000 miles at average speeds up to 300 knots. Or 2,900 miles with a whopping 35,000 pound cargo. The big propjet C-130E meets these requirements for airlift operation: straight-in end loading; truck-bed height cargo floor, air-conditioned, pressurized cargo compartment, and the ability to lift, land, or airdrop heavy, bulky pieces of freight.

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Integral bearing permits direct gimbal mounting

The new Reeves 10 second Resolver is the ideal instrument for precision stable platform applications. The units are available with either beryllium or aluminum housings for a wide range of operating temperature applications.

Reeves is especially proud of this latest addition to the comprehensive family of high precision resolvers currently in production and ready for inclusion in your systems packages. Whether your resolver requirements Reeves has the size and design to meet your specifications. Reeves Resolvers are supplied in the 25, 15, and 11 case sizes. For complete specifications, write for data file 712.

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these advanced fields are in-
vited to get in touch with us.



70-101

New Offerings

Delta Design, Inc., San Diego, Calif., engaged in the design and development of portable control chambers for use in the evaluation of solid state electronic circuits, controlled atmosphere processing chambers and petrochemical high vacuum system components. On being a 100,000 shares of capital stock, for public sale at \$4.34 per share, to be made through company efforts and employees. Of the proceeds, \$310,000 will be used for the acquisition of land and the construction thereof of a factory to include office space and laboratory facilities. \$113,000 for the purchase of new machinery and tooling and research equipment, the balance for financing additional inventory and for working capital.

Texas Research & Electronic Corp., Dallas, Tex., engaged under Memorandum of Understanding, 1963, the company proposes to engage in various phases of the electronics business through the acquisition of one or more existing businesses. The company has not as yet made any arrangements to acquire any business, and there is no assurance as to when it will be able to commence business operations. Offering is 600,000 shares of common stock, for public sale at \$1.15 per share. The proceeds, together with \$400,000 cash on hand, will be used in the negotiation for and acquisition of one or more small businesses. It is estimated that \$10,000 will be used in connection with setting up the company's office and after initial expenses.

Speed Instruments, Inc., Ft. Worth, Tex., (formerly named D & H Instruments Co., Inc.) engaged in the design, development, manufacture and sale of precision electronic and electro-mechanical instruments for use in timing instrument systems, and for measurement, automatic control, and recording applications. Offering is 140,000 outstanding shares of common stock, for public sale for the present holders thereof, offering price and no discounting terms to be supplied by amendment.

Madison Electronic Corp., Clark Plant, N. Y., engaged in the design, development, manufacture and sale of electronic equipment for use primarily in weapons systems and data processing systems, of also offers specialized field engineering services and technical publications. Offering is 110,000 shares of common stock, at \$4.25 per share. 40,000 shares will be offered for sale to certain employees of the company and their relatives, purchasers of the company's products and to outside offer-



Love Field Installs Center Line Lights

Delta Air Lines Douglas DC-4 plane over tower of new Conquester 1331 at Love Field, Dallas, Tex. Section is expected to be operational Jan. 2. New system, extending 1,000 feet from the entrance of the runway, is approximately 100 ft. higher than last field approach light system now in use. Federal Aviation Agency is funding the \$200,000 cost of installing the new system, which will have Delta's Electronic approach finding, center lights and Ground Glarefield solid beam lights and sequencers.

person known to the company who have indicated an interest in its affairs, 30,000 shares will be offered to persons associated with the underwriter. Of the proceeds, \$200,000 will be applied in reduction of a \$493,500 bank indebtedness the balance for working capital.

The Foshens Co., Foshens, Mass., engaged in the manufacturing of industrial instruments for radiating, recording and controlling temperatures, pressure, flow, humidity, liquid level and other process variables, presently for use in the process industries in the manufacture or conversion of raw materials into finished or semi-finished goods. Offering is 221,000 shares of common stock, 125,000 shares for public sale, in the issuing company, and \$6,000 outstanding shares in certain holders thereof, public offering price and underwriting terms to be supplied by amendment. Of the proceeds \$100,000 will be used for construction of all different warehouse facilities at the company's Foshens plant, 500,000 for construction of plant facilities at Foshens, Foshens, Mass., for the production of the company's Electronic Controlled line of instruments. \$80,000 for ad-

ditional plant facilities for the company's Dutch subsidiaries, \$410,000 for the plant facilities of its Canadian subsidiary, the balance for working capital requirements.

The R. F. Goodrich Co., New York, N. Y., engaged directly and through its subsidiaries and associated companies in the manufacture and sale of tires and tubes, and also products for the aviation and space industries. Offering is 940,000,000 of ordinary bond debentures due November 1985, for public sale after cut rate, public offering price and underwriting terms to be supplied by amendment. Proceeds will be added to the company's general funds to be available for capital expenditures and other investment matters, as well as for additional working capital expected to be needed during the next six to eight years. As of Sept. 1, 1963, approximately \$62,000,000 (including amounts actually converted) had been authorized but was expended for additions, improvements and replacements of operating facilities, including the construction of a five plant in Fort Wayne, Ind., and a new plant in Kalamazoo, Ontario, Canada, as well as the construction,

Two Douglas DC-8 turboprop transports of Aerovías de México and Entero Air Lines are shown at New York International Airport as return from post-inaugural flight to Mexico City (AM Nov. 28, p. 43). **Italic** flights begin earlier this month.

Elcom Instruments, Inc., Bristol, Pa., worked on the design, development

Offering a \$8,000 outstanding loan of capital stock and five new shares to purchase 8,000 new capital shares for public sale in such (such as) setting of one share of stock and one share of stock so that it be made less than 10 cents. Public offering of the stock will be placed in the hands of the company's stockholders, the company's market share, the stock immediately prior to the offering, and the stock to be supplied to the company. All the shareholders of

Herbert A. Elson, president, and Robert J. Zupke, vice president, promise to sell 50,000 shares each, and are agreed to lead the company stock sale. Elson previously received his share from the bank. Proceeds from the loan together with the 50,000 shares the company is selling of 20,000 stock purchase warrants will be used by the company to pay off its bank loan accounts.

Slack Services, Inc., Burbank, Calif., engaged technicians as a contract and charter carrier until July 4, 1968, when it diversified into the manufacturing field by the acquisition of the assets and assumptions of the liabilities of **Thruway Truck Cloth Corp.** The company has agreed to purchase from **Casecar, Ltd.**, a new model C3-HD heavy-duty powered aircraft (and related spares, parts and five-year engine), on which it is obligated to make payments, in 1969 aggregating about \$1,797,000. **Slack** plans to finance scheduled 1969 **Slack** payments on the aircraft by the sale of

The offering is 600,000 shares of common stock, for public sale, with no prior and underwriting firms to be supplied by management.



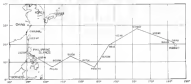
The Space Plus Airborne System handles, reduces, and displays 84 MHz and low-level analog channels, then compresses them into 15-bit digital data. The data is then sent to the host computer in the test aircraft. When the plane returns to ground, the digital tape is played back on the Space Plus Ground Station and the test data efficiently stripped, edited, and recorded in computer format for direct entry into Republic's IBM 704 computer. Through this high-speed data reduction process, all flight test information, including a full compressional analysis of the 4-1/2 sec ion loss compressions, is available by the next day. The data is then processed by the Space Plus computer, which can handle 100,000 words from Republic's 8-bit test data analysis time, automatically generating the 4-1/2 sec ion loss compression.

The advanced PCM system Model PCM-6030 also may be supplied with various channeling capability. For further details, write for Bulletin AT-600 PCM.

Image left: Open a PER General Session between academic events and visiting lectures to share and discuss data for a subject, propose new for almost every site. Number 1, 100 000

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Engineer inspects Styroflex® cable inside an antenna array at one of Pacific Scatter Communication System stations shown at right.



Over 40 miles of *Styroflex*® Coaxial Cable help assure

More than 300,000 feet of Styroflex® coaxial cables are in active use as balanced antenna feed lines in the recently completed Pacific Scatter Communication System stretching from the Hawaiian Islands to Okinawa. This trans-Pacific system, one of the largest and most advanced of its kind in the world, uses ionospheric and tropospheric propagation techniques that produce over 99% reliability. An important part of the Strategic Army Communications Network (SACOM), the system was designed, developed and constructed by Page Communications Engineers, Inc. for the U. S. Army Signal Corps.

Each of the nine stations in the network is equipped with the same major component parts—transmitters, encoders, multiplex terminals and antennas. The cables used in the 300- and 400-foot antenna arrays range from 3/4" jacketed Styroflex® cable to 3/16" jacketed Ponderflex® cable. About 7,000 feet of 1/4" jacketed Ponderflex® cable is also used in the system. The Styroflex® cables were spliced in the field by an inert-gas helium welding process to assure noise-free connections required for successful duplicated antenna operation.

The extremely low inherent noise level and low attenuation of Styroflex®—together with this air-

Pacific Scatter Communication System reliability!

dietric cable's stable electrical and mechanical properties—especially qualify it for the critical specifications of this transoceanic system. If your system requires

reliability, investigate the successful record of Styroflex® (Photos courtesy of Page Communications Engineers, Inc.)

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- for the power forms of tomorrow

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pneumatic and mechanical devices for missiles and space vehicles. And for the power forms of tomorrow, Hamilton Standard research is furnishing new ideas for control of an engine, fuel cells, magnets and industrial gas turbines.

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B-70'S AIR INDUCTION CONTROL SYSTEM, now under development at Hamilton Standard, involves some of the most advanced control problems ever encountered. It is designed to provide the most efficient air flow into the plane's engines over an extended range of operating conditions.

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ENVIRONMENTAL MONITORING SYSTEMS for space vehicles and such advanced aircraft as the F-105, F-106, B-70 are important aspects of Hamilton Standard development.



GROUND AIRCRAFT EQUIPMENT, Hamilton Standard is presently providing a wide range of GAE for both military and aircraft—both types of tests to complete systems.



ELECTRONICS at Hamilton Standard includes broad experience in flight control, navigation, fuel, electric power generation and electrical control for aircraft, missiles and GAE components.

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Skilled hands, close attention to manufacturing techniques, quality control and a deep pride in a product well made...all are intrinsic to the reliability pattern at Electro-Tec. In the many stages between design and finished product, these factors are so balanced that desired component reliability becomes a reality every time. This mix of fine craftsmanship and excellent manufacturing capability is one of our most valued assets. ELECTRO-TEC CORP., South Hackensack, N. J.—Blacksburg, Va.—Grand Beach, Fla.



for landing. The controller indicated that the west rift line the jet flight would occur when it entered the terminal pattern at the end of the runway.

The testimony of Lt. Anderson was an exception. He stated that his flight passed to the right of the Ft. Warren hangar, located two miles ahead beyond the end of the runway. He stated that approximately three miles from the hangar he began a left turn 15, and it was a climbing turn and that the clouds were cleared after the T-15 was located. Power was applied, and the aircraft was clearly ascending with great speed, going up. The left hand turn 15 deg. Lt. Anderson estimated the left turn to 110 deg., approaching it over on a heading of about 180 deg. to show the turn. Capt. McChesney stated in the turn in three turns. He took position on Lt. Anderson's right wing with his aircraft slightly below the level of Lt. Anderson's with time to see but enough separation from, and left to fly the old line." At the time proposed the flight ascended to 270 ft. 140.

Before precision, planning and coordinated maneuvers were important considerations in a satisfactory performance of the evolution. Lt. Anderson planned to reach 8,000 ft. 270 ft. and the 110 deg. heading simultaneously. For all practical purposes that was done and both pilots estimated that it occurred about 10 sec. before the collision. The pilots testified it was clear to them that at this point Lt. Anderson was the formation leader and Capt. McChesney was the wingman. Accordingly, because of formation requests, the wingman's attention was divided between the leader, the wingman's ability to see and avoid other aircraft was entirely that of the formation leader. This is in accordance with Civil Air Regulations and military directives.

Cleared the Area

Lt. Anderson stated that he clearly understood his responsibility and believed he had maintained a careful look out the entire trajectory. In his testimony he mentioned stopping the turn about 150 deg. to clear the area, particularly in the direction he intended to continue. He testified that during the last 50 sec. he scanned the left quadrant then straight ahead, and then the right quadrant. Lt. Anderson stated that at the time he was scanned he also checked Capt. McChesney's position. He stated that when he returned his vision forward he saw an aircraft coming directly in front of him and made a sudden path to avoid it. He said it did so close to quickly he had no time to warn Capt. McChesney or even to identify the plane. Lt. Anderson said in retrospect he believed that he had scanned the other aircraft to a visual distance and was not so limited to the area where the birds were limited but had seen it. He further indicated that except for brief attitude, approach, and heading checks there were no other air contacts which required his attention within the cockpit.

Capt. McChesney testified that his attention was concentrated on the formation heading and therefore on holding their position. He was generally aware that heading, speed, and altitude were in Lt. Anderson's control. He was also of the opinion that these factors were constant for at least the final 30 sec. before collision. He said that to be

in the collision itself was concerned in a relief of his responsibility as actual leader, because, in fact, assumed he had collided with the T-15 which had been oriented in the traffic pattern.

A concentration of small, faceted pieces of the Beechcraft and its associated wreckage were found 4.1 miles southeast of the southern boundary of the airport. The wreckage marked the approximate location where the collision occurred. The F-105 crashed about 1.5 mi. southeast and the Beechcraft about one-half mile south of the location.

Disintegration of the Beechcraft started the southward crash ground at 400 yds. down on a westerly heading. The wings were attached to the cabin, however, the section from the cabin showed no deviation. The forward fuselage was not.

Examination of the Beechcraft structure provided clear information relative to the flight impact sequence. It showed that the F-105 nose and fuselage structure above the wing presented the right side of the Beechcraft's right wing at about 100 ft. a portion and all of the rear fuselage section. The fuselage frame remained attached to the cabin structure side of the fuselage was destroyed. On the opposite side of the Beechcraft fuselage most of the rear cabin section and all structure between of about 110 ft. were destroyed. Between the left and right sections there was a clear line of destruction which formed an angle of approximately 110 deg. through the fuselage structure. The lower fuselage structure in the fuselage section of the Beechcraft. The manner in which the structure was altered showed that the line of clearing was from right to left, having debris was no discernible evidence of vertical forces.

The fact that the Beechcraft wing showed no slight contact damage indicated that the right wing of the F-105, present below the plane of the Beechcraft wing. Because the F-105 was nearly straight and level at impact, the fact that the wings of the Beechcraft were nearly straight and level. Fuselage calculations based on the heading and speed of the F-105, the approximate speed of the F-15 and the 110-degree line of separation through the Beechcraft's fuselage, show a heading for the Beechcraft at impact at 150 deg. magnetic. From this known position in the collision it was found that the Beechcraft was flown straight and level on a heading for a period which he estimated to be three to five seconds before the impact impact. Although the pilots thought the Beechcraft pulled up and its heading was in the southeast, the impact, the impact evidence clearly indicates that either occurred after the collision or at a time as shown caused by the two planes of different rates and speeds increased and collided. The approximate time of impact of 175 ft. for the Beechcraft was found on the manufacturer's operating data for the aircraft at normal rates, and at 175 ft.

It is noteworthy that a noticeable variation in this speed factor above or below normal rates in the evidence will not appear until the computed heading of the Beechcraft.

The Citizens' Unmanned Aircraft is in view on the western side of the city. In

Micromega parametric amplifiers give you this performance consistently



For each amplifier, the gain is plotted against frequency. The gain is consistently high across the frequency range. The gain is plotted against frequency for different amplifier models. The gain is consistently high across the frequency range. The gain is plotted against frequency for different amplifier models. The gain is consistently high across the frequency range.



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addition to being the home base of the Air National Guard Squadron it also serves those identified as carriers and considerable fire and aviation and military traffic. The airport has a conventional 10,000-ft runway, control tower and extensive runway safety traffic patterns, one hot light runway and the other for heavy traffic. The first is closed and the second is used for the military. The use of the airport is additional for the F-15s; they are tactical approach and Mid-day is closed landing pattern. All of these patterns were published and disseminated locally. The use of the airport by the jet fighters and the fact that they made substantial low approaches were also published in the Arizona Gazette according to its publication pro-

Another factor relative to this column is that the F304, high volatility VHF (ultra high frequency) communications and the Bechtel unit was equipped with VHF (very high frequency) communications. The tests did not use direct air tests nor really consisted on both VHF and UHF communications. The F304 pilot and the Ecomet pilot, therefore, could not establish radio communications made with respect to the other.

From the rituals, gathered as an end result of investigation it is apparent that the violence occurred outside of the Chavacano community. The Chavacano community is the result of the intermingling of the Negro and control zone in colonial which both Negroes were being made an African village and in another condition as an N-10. Under these circumstances Card An Kapulungan's purpose upon the pilot of the Chavacano community is to be a community through social interaction to be a community of other citizens. The Civil An Kapulungan state state rights regarding captured way and the Chavacano community is to be a community through social interaction to be a community of other citizens. The Civil An Kapulungan state state rights regarding captured way and the Chavacano community is to be a community through social interaction to be a community of other citizens. The Civil An Kapulungan state state rights regarding captured way and the Chavacano community is to be a community through social interaction to be a community of other citizens.

Analysis of the factual information and physical evidence back the Board to the determination that the traffic contact sequence began with the Beardsmith as a heading of 114 deg and the F38L on a heading of 130 deg. Initial sight contact occurred when the F38L nose structure contacted the fuselage of the Beardsmith and behind the wing and cabin window.

The sequence progressed as the nose structure above the wing of the F4U generated lift out through the Bendcraft linkage at an angle of 110 deg. to the fuselage controlling sustained climb from the nose. Forces attending the sequence showed off the Bendcraft linkage at the sixth flex while the rapid nose

Because the rhyolite T380, was a straight and level light during the sequence and because the wings of neither rhyolite made contact it is more apparent the Rhyolite was also straight and level. This is substantiated by the lack of any vertical deformation to the structure involved in the rhyolite. These factors raise the issue to believe that an event when occurred which should indicate the Rhyolite pile was the E380, the rhyolite stage.

To part of the Board's action a series diagram was prepared using the disassembled wheel material according to the study. In this manner the probable flightpaths of the wheel were determined for the 5000 period of slower gross to the collision. From the study it was possible to determine the relative position of each wheel to the other at any given period. Similarly, it was possible to assess the opportunities afforded each wheel to have initiated the other's failure as well as to avoid the collision.

The study shows that at the beginning of the 1950s period the collecting activity was spread over the whole of the lake. The first station was located 87 km from the shore (in the name of the first fishermen leader's surname). It would have been slightly outside the zone of the lake's maximum productivity (which prevents a significant increase). During the first 30 km² while the 1950s was running the major position was located 100 km from the shore, about 70 km to the NE of the nose of the lake's mouth and to approximately equalled during the final 30 km with the 1950s. The 1950s was the zone of the Blackhead mouth was not reached.

The study also shows that at the beginning of the 60s period the collecting activity was concentrated 200 km to the right side of the nose of the Blackhead, as approximately 40 km to the west of the nose of the lake's mouth. The activity has been located the level of the Blackhead. During the last 30 km and the position of the first fishermen would probably shift to the right side of the lake, to the right angle of 180 deg to the east at the nose of the C.M. During the final 30 km this position would move to the right side of the lake.

From desirable evidence and analytical study of this accident it is the conclusion of the Board that an overstating situation occurred in which the F-16D, *inspite* of correct Rotorcraft fuel in sight as the Board concludes that during the 50 sec. period of time that the aircraft was in position and well within the forward view quadrant of its jet engine intake and that it presented an adequate profile for visual detection within the distance which separated the aircraft. The Board therefore concludes that there was an adequate opportunity for the jet intakes to be seen and the likelihood is that it was not a matter of visibility or recognition as to the aircraft's presence in accordance with the susceptibility of its sighting plot.

At all times during the 88-sec period he saw evidence the jet formation was positioned well to the right side of the Beach club. This position was as much as 125 deg and was never less than 100 deg. It is likely

stated that a pilot's primary responsibility is to direct his attention to the more critical area, which is the 180 deg quadrant ahead of his aircraft. While this is not intended to mean that a pilot should not work all areas available to him, it does mean that his primary effort should be in the direction of light rear sensors that an overwing pilot will usually handle the same responsibility. Accordingly, the Board does not believe that the opportunities afforded Lane were sufficiently adequate to have resulted there to have been a

The Board believes that the action to be taken by the National Council will be to require the utility pilot to assume its role through an active process as an effective means. It is believed to be effective so that the engagement will provide positive indications of both plans to each other as the difficult task of looking for other assets. The second action taken out to meet the previously mentioned plans to initial approach. This was also done in the Air Ground unit. The Board believes that if there is a concentration of traffic in the Gateway Airport area between 1,000 and 4,000 ft, there is either a higher altitude by the

The Board determines that the probable cause of this accident was that during an overriding situation the pilot-in-command failed to see the Berkhof as true to lead his wingman off collision course. By the Civil Aeronautics Board.

WAYNE GRAMADO
Chairman
G. JOSEPH MARITTI
Member
ALAN S. ROY
Member
J. S. RABINOW
Member

Don Carey, Vice Chairman, did not participate in the selection of the board.

The Civil Aeronautics Board was notified of the accident shortly after it occurred on Dec. 15, 1964. An investigation was initiated in accordance with the provisions of the Federal Aviation Act of 1958. Depositions, ordered by the Board, were taken in Cheyenne, Wyo., on Feb. 4, 1965.



Area 740s being built for Hawker Siddley Aviation are on the production line at the Chislehurst (Vauxhall) factory of A. V. Roe & Co., Ltd. Firm orders for 15 of the 44-seat bomber aircraft have been received from several British airlines, and the aircraft is also being built under license by the Indian Government. The first production aircraft is due for delivery to Reynolds, Ltd., next year. Two Rolls-Royce Dart Mk.514 engines, each developing 1,540 h.p., power the 740, which was first flown in June, 1952.

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At Chief Wren and was the most
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Inc., just owner of the Bencher C-31.
He held a private pilot certificate with
single-engine land rating issued by the
Federal Aviation Agency, Jan. 29, 1959.
FAA records indicate that at that time he
had acquired 79 hr of flight of which 6 hr
was in instrument, the other 23 hr was
in, all which 51 were cross-country. At
that it can be determined, at the time of
the accident he had accumulated a total of
575 hr of flying. Even undoubtedly period,
without record, a C-31 medical exam
on Apr. 22, 1959.

Capt. William F. Madson, age 38,
resided in Dulles, Va. At the time of
the accident he was employed by the 157th
Fighter Interceptor Squadron of the 46th
Air National Guard as an air testing
supervisor on a full-time basis. He was
a rated pilot on flying status and possessed
a 52 (check) instrument rating issued by the
Air Force. Capt. Madson also held a
commercial pilot certificate, with single
engine land and instrument ratings. He held a
commercial pilot certificate issued by the
Air Force. Capt. Madson had a total of 2,490 hr. Of this total 1,219 were
in instrument, a total of which 389 were in
the F-56, aircraft.

First Lieutenant Donald T. Anderson,
age 39, resided at 1561 Chester Avenue,
Coke and was employed as a personnel
pilot. Lieutenant Anderson was also a
member of the 157th Fighter Interceptor
Squadron in a part-time status office
for over a quarter of a century. He was a rated
pilot on flying status and held a 52 (check)
instrument and rated by the Air Force.
He also held a commercial pilot certificate
with single engine, multi-engine and instru-
ment ratings. Lieutenant Anderson held
commercial land FAA and Air Force medical
certificates. He had accumulated a total of
1,600 hr of which 480 were in cross-
country and 600 were in instrument, a total
of which 580 hr of hours of which 270
were in the F-56, aircraft.

Bencher C-31 N, 15750, was ac-
cidentally on March 1972 in the Boca
Raton, Fla. Accident records indicated
it was purchased by its present owner
Mr. J. J. 1959. The next cross-country
inspection was performed July 24, 1960.
At aircraft inspection had been com-
pleted with and records indicated the aircraft
to have been maintained in an airworthy
condition. A standing instrument check
a total of 1,704 hr for the aircraft and a
log entry of engine overhaul on Jan. 18
1958 indicated that since this the engine
had operated 777 hr. The engine was a
Continental, Model F-555-15, and it was
replaced with a Bencher propeller, model
21511P. Serial number 214797-6.

Model, 91-1062 was manufactured by
North American Aviation Inc., in 1955. It
was purchased and maintained by the 157th
Fighter Interceptor Squadron based on the
Cheyenne, Wyoming. Maintenance report
Serial number indicated it had flown
984 hr, of which 25 were since last over-
haul. The last two cross-country and per-
form inspection was performed Jan. 11,
1959, the day of the accident. The aircraft
was powered by a General Electric T4-C-12
T1 turbojet engine. Total time on the
engine was 405 hr.

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BUSINESS FLYING

Germans Completing RF-1 Pusher Plane

By Edith Waldorf

Karlsruhe-Ludwigs, Germany—Final assembly of the first prototype aircraft two-engine, 30.5-cubic-meter, aircraft, built by Rhein-Flugzeugbau GmbH, a new aircraft company at the company's plant here.

Final delivery of a specially adapted Harrier propeller from the United States and the completion of some minor alterations being made to the plane's perceptual aviation flight trials are scheduled to begin shortly.

Engineer Hans Guckler, who also developed the RW-1 Monoplane, now in home production at Ludwigs (AW June 10, p. 28), is responsible for the RF-1 design.

Design Details

The RF-1 is a shoulder-wing monoplane structure made chiefly of plastics to reduce maintenance costs. Like the RW-1, it features several unconventional design details aimed at improving its STOL characteristics and enabling the plane to operate from unpaved ground and grass strips.

The aircraft is powered by two lightening O-445A engines rated at 740 hp, each at 2,575 rpm. They are installed in the wings and drive a single, pusher-type Harrier propeller. A free-wheel clutch enables the independent operation of either engine. If one of the engines fails, it can be decelerated automatically, without adversely affecting the performance of the plane.

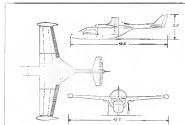
The novel design features consisting

RF-1 Specifications

Dimensions	
Wingspan	43.0 ft
Length	42.5 ft
Height	12.6 ft
Weights	
Empty weight	3,570 lb
Useful load	8,965 lb
Gross weight	5,655 lb
Wing loading	17 psf
Powerplant	
Two 250 hp, Leaning O-445A engines	500 hp
Fuel	
Normal fuel capacity	95.1 U.S. gal
Fuel capacity of auxiliary fuel tanks	16.4 U.S. gal
Fuel consumption at cruising speed with both engines	30.6 gph



RF-1 structure plane features half ring wing, thrust deflection flap and a pusher propeller mounted in the wing. Assembly is scheduled to begin flight trials shortly.



THREE-VIEW OF RF-1 monoplane points up straight leading edge and wing thickness for stability. Airplane has short thrust and load characteristics. Note swept tail (below).



RF-1 Monoplane Performance

Normal endurance	5.5 hr
Endurance with auxiliary fuel container	4.8 hr
Normal range with 30 min. reserve	481 mi.
Range with auxiliary fuel container and 30 min. reserve	970 mi.
Maximum speed	180 mph
Cruising speed	104 mph
Takeoff distance (at 5,655 lb.)	340 ft
Takeoff distance (at 5,995 lb.)	382 ft
Rate of climb (at 5,655 lb.)	24.2 fpm
Rate of climb (at 5,995 lb.)	15.1 fpm
Service ceiling (at 5,655 lb.)	21,600 ft
Service ceiling (at 5,995 lb.)	20,500 ft

of a half ring wing, thrust deflection flap and the propeller mounted in a ring have combined to form a mutual effect resulting in increased lift and thrust and enabling the plane to take off after a ground run of about 300 ft.

The low drag fuselage, fitted with an electrically operated retractable in-cabin landing gear, allows passengers to board the aircraft without the aid of steps or a ladder.

Passenger Seating

The cabin accommodates six passengers including the pilot. Pilot and six passengers sit side-by-side in the cockpit and the remaining four passengers sit on the two facing benches in the rear of the cabin, which are separated by a folding table.

In raising the two rear benches, the plane can easily be adapted for flight-carrying or ambulance duty. Two legs down, one on either side of the cabin, open in the middle and fold back, upward and downward to simplify load up of bulk baggage or freight. When used as an ambulance, the RF-1 can accommodate up to four stretchers in addition to the pilot and cockpit, a doctor or nurse.

A definite price for the RF-1 has not yet been fixed, but Rhein-Flugzeugbau says it will probably cost about \$55,000 (\$700,750,000).

Biologist Seeks Data On Waterfowl Flights

Reports by avian and marine pilots on migration and navigation patterns of waterfowl (ducks and geese) are being collected by Eugene Decker, D. I. Emerson, Fla., a waterfowl biologist. He is seeking reports on (1) waterfowl flocking at altitudes above 4,000 ft, (2) flocks above or between cloud layers, (3) flocks flying in opposite directions, i.e., east and west, and (4) any other unusual flight behavior. Decker is seeking pertinent reports giving dates, time, location and weather during the observations.

AVIATION WEEK, December 15, 1960

Bell Helicopter Cuts 1961 Model Prices

By Worth, Tex.—Significant price reductions will cut Bell Helicopter Co.'s line of 1961 conventional models in line with firm's intention to stimulate sales and new orders at a faster rate.

New versions of the HTG will sell for \$152 less than 1960 models and the sensitive four-blade HTG will sell for \$1,500 less than last year's version. Prices of the 1961 models will be Model HTG-1A, \$18,450; Model HTG-3, \$41,500; and Model HTG-4, \$60,810.

The helicopter also are needed by

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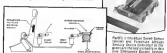
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significant technical improvements in increasing performance and cutting operating costs. This will be displayed at the first test of Helicopter News of America's annual meeting in Madisonville, N.J., Jan. 15-18.

Helicopters are that Bell Helicopter Corp. is getting set to produce a final, although its commercial sales and its replacement of helicopters for law enforcement and charter operators and is aiming to fill the industry's normal growth needs spread more deeply from their steady upward of the past. In addition, management is aware that the impact of Canada's entry into the helicopter field with its four-place C81HC—considering its strength and fixed-wing manufacturing line—has provided a competing force that requires leading killing conventional sales efforts than another person in the rotary wing industry.

Bell Helicopter President E. J. Donnell said that the price reductions were made possible by standardization of all three models by designing for maximum interchangeability of components and use of rigid cost controls.

Standardizing in the Bell helicopters for all three models was not only possible production cost cuts because of simplifying procedures but a higher volume in parts also reduces their manufacturing costs. It is expected that this philosophy will also encourage sales, since interchangeability of components will provide direct operation with savings in spare parts required, simplified maintenance and reduce in cost.

Interchangeable Parts

All three models will have interchangeability of dynamic parts including main and tail rotor blades, main rotor hubs, transmission and control parts. In the case of the three-place 470-2A and 470-3 which models, the only difference is the engine. Not only are dynamic components the same but also the control system is identical. Use of larger, off-the-shelf engine cylinders and location of the landing light switch and starter button on collective pitch handles on all three models also is noted in reducing maintenance and repair handling. They are also both used features of the 1964 Bell Helicopter line.

Model 470-2A Trooper, powered by a VVO-415 Lycoming engine of 240 hp for takeoff and 120 hp cruise, features a 400 lb payload increase for a new certified gross weight of 2,810 lb and will have a top speed of 105 mph, 5 mph higher than last year's version. Performance increases are possible by use of the Model 471 rotor system which incorporates main blades 2 ft longer in diameter than the 470-2A's shorter version. New tail rotor of the new 470-2 is 1,212 ft. Interchangeable

of the 471's rotor system and 470-3's longer tail boom has provided important improvements in handling characteristics. Bell pilots said. Delivery of the 470-2A will begin in January.

Model 470-3, which features high altitude performance through use of the turbo supercharged Franklin 6V95 355A of 240 hp for takeoff and 120 hp cruise, features a 200-hp payload increase, bringing useful load to 1,241 lb with maximum gross weight of 2,810 lb. First deliveries of this model also are scheduled for January.

Model 471 Trooper has had the takeoff power rating of its VVO-415 on gross weight of 2,810 lb, while the continuous rating remains at 220 hp. Performance increase makes it possible for the aircraft to have useful load on climb out of gross weight. The new model will be able to lift up to 1,220 lb and load up to 1,090 lb at all altitudes as in excess of 10,000 ft for most operations. The 471 line is final design of certification is expected to be available in early 1967.

In addition, the new models will include flexible seat cushions, improved sound insulation and variable flow cooling. Seats and fuel controls on the 470-2A and 470-3 will be available in a choice of five colors, white, light blue, green, orange and red. Standard 471-2 version are the same material with a selection of three colors. De last version for the 471 is available through Helicopters and Helicopters in regional stores.

FAA Realigns Rules For Modified Planes

Washington—The Federal Aviation Agency has adopted a program which is designed to accelerate the certification of aircraft modified for business aviation.

The new program was developed by the FAA in consultation with principal aircraft manufacturers, major airlines and corporate owners of aircraft. The purpose of the program is to ensure promptness and uniformity in certification which takes about 1,000 hours the past few years. It aims at the major parts of the program:

- Improved criteria for determination of safety and performance between FAA regions will be put into effect. Special office in Washington headed by a chief modifications engineer is being established to coordinate distribution of data. Systems is expected to require uniformity in interpretation of modification data.
- Industry will be given more authority in modification programs through a new meeting to be known as Approved Modification Stations. Such stations will have authority to approve supplemental

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For more information please write to: Mr. A. M. Bowman, Engineering Personnel, North American Aviation, Inc., International Airport, Los Angeles 65, California.

THE LOS ANGELES DIVISION OF

NORTH AMERICAN AVIATION, INC.



Russians Develop Sports Monoplane

Russia's Kharkov Aviation Institute has developed two light, pusher-type sports monoplanes designated KMAI 17 (shown) and KMAI 18. The single-plane KMAI 17, powered by a 30-hp engine mounted behind the cockpit, weighs 772 lb., "can fly many hundreds of kilometers unrefueled," and has a ceiling of 5,200 ft., designer claims. Top speed is about 90 mph. A two-place, "high performance" version of the KMAI 17 has also been designed. Designated the KMAI 21, it closely resembles the KMAI 17 but is equipped with a 50-hp engine. Top speed of the KMAI 21 is over 124 mph, and range is "over 1,000 mi." Gross weight is 1,102 lb. First public demonstration of the KMAI 17 is scheduled for next summer.

type certificates covering their own modifications.

•FAA will work with industry to develop improved guidance for FAA field personnel. Manufacturers will be asked to provide manuals in this connection.

•Industry will consider drafting and proposing to FAA a new Civil Air Regulations section pertaining to large aircraft used for business purposes to streamline modification procedures.

•Industry has agreed to enhance planning in modification operations as a means of providing FAA with sufficient warning of peak work loads, particularly when adequate scheduling of required tests cannot be arranged.

ADMA Members Told To Make Sales Effort

Faha Springs, Calif.—Plans to further expand business and customer aircraft sales by concentrating on the 90% of companies which could, but do not, effectively utilize light/mediums were outlined by the Aviation Distributors and Manufacturers Assn. during their 36th meeting held here.

Members generally agreed with a panel headed to forecast the economic outlook that business aircraft growth can be as high as 10% of the program which can effectively utilize



Spray Pump Fitted to Piper Pawnee

Agricultural Aviation Engineering Co., Santa Clara, Calif., has developed Series 6600 light weight spray pump, shown installed here on a Piper Pawnee ag plane. Pump has application rate in excess of 50 gal./per acre. Thru line is available; fixed pitch metal and woodline bars and adjustable pump unit. Price starts at \$77.20.



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ships. In the past, distribution and maintenance have slowed the acceptance of new aircraft. But ADMAN President Paul A. Kennedy of Southern Aerospace Corp. recommended that the association develop a nationwide advertising campaign.

One single advertisement offered to carry a graphic line customer's business transportation requirements and sales communications as to the type of aircraft suitable, approximate initial cost and operating expenses. It was noted that further study would be given such a campaign and action taken to analyze advertisements in a nationally coordinated business response.

Rather than allowing a "Test Case" to be a "Test Case" in proving business aircraft sales, Kennedy urged ADMAN members to support companies to all aircraft manufacturers at benefits from increased sales would come to members in the form of increased business.

Growth of the general aviation market was projected by H. W. Miller, Chairman, Learning Division of Aero Corp., who was elected a vice president of ADMAN. Total retail sales in 1979, he said, are expected to reach \$1.5 billion. This is up from \$1.1 billion in 1978 and \$1.0 billion in 1977. General aviation sales in 1979 are expected to reach \$1.5 billion in 1980. General aviation sales in 1980 are expected to reach \$1.5 billion in 1981.

estimated that the 1980 figure would double to \$3.0 billion by 1985, and double again to \$7.0 billion in 1990. From 1970 to 1980, he estimated, would increase from 6.3 million to 10.0 million in 1970 and the number of business aircraft would increase from 11,500 to 68,000 in 1979.

Greater utilization of business aircraft can be related only if ability to operate an instrument aircraft is afforded the single pilot aircraft and the Federal Aviation Agency's Bert A. Deane described a research project under which instrument aircraft could be standardized. The FAA, Deane said, has offered to meet business and general aviation aircraft manufacturers in designing an instrument panel which will allow space for all components necessary for instrument flight. Present aircraft, especially single engine, single place types, do not have the space within the instrument for electronic installation nor room on the instrument panel for placement of display instruments. If a standard panel were accepted by all aircraft, each aircraft could be equipped according to the pilot's ability and desire without having instruments located outside the pilot's reach in use. FAA has offered to fund such a research project jointly with business aircraft manufacturers.



MOOSE, chased into an Ontario lake by Bell 40G helicopter, is tagged by a forestier.

Moose Herds Tagged by Helicopter

Ontario Department of Lands and Forests is using a Bell 40G helicopter for large-scale tagging of moose in rugged lake and forest country, eliminating the former hand-on system of tagging.

New system was devised by the department's D. W. Reardon and R. H. Stone, with Bell in pilot. In Sep-

tember, the team in 11 hr flying time tagged 30 moose out of 73 observed from the air. Nine were bulls, others were cows, calves and yearlings.

In addition to the tagging, in which foresters combed the moose with the cattle, the helicopter prevents and helps to spray paint on animals from a landing position. However, the

work in the fields of the future of NASA.



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LOS ANGELES DIVISION

**NORTH
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AVIATION**



under one usually worked off and that was of no research value, particularly in civilian aircraft development.

The helicopter now permits take, where some find an engine engine in the shafts from early spring until the winter season. In flying low, the helicopter develops the same engine, doing so, taking it to the water. But then leads the aircraft, now out to the ocean, and an officer tips the car from the position.

Man events for the engine are to check movements, a unique engine only over limited areas, leaders could be given the entire population in a matter of years.

Civilian Fish & Wildlife Service will evaluate data on the basis of top rated by leaders.

PRIVATE LINES

Rollout of the first production Piper Cherokee four place lightplane (NAV News 10, p. 118) will be a feature of the 10th birthday celebration of W. T. Piper, Piper Aircraft president, at the company's new Vero Beach, Fla., plant Jan. 3. Piper also will dedicate the new facility, built for production of the new Cherokee. Open house will be held from noon to 5 pm.

SAF-Marchetti Review amplifiers will be supported to U.S. by Linc Aircraft Co., Dallas, Tex., for marketing at a \$35,000 sales price. From-place plant will be available at Linc Field in Southeast Airborne.

Seafight Corp., designer of a new seaplane at Padua, Pa., has completed its development work with the engineering staff of Vanguard Air & Marine Corp., which is developing Grumman VTOL (NAV Feb 18, p. 58). The new Seafight plant will be designed to be built in a submersible or water resistant area. Manufacturing facilities of Vanguard's Northeast Marine Industries Division will be used for seaplane production. Expanded staff also will work on the development, which is scheduled for first flight about May 15, 1981. Aircraft now has completed tests at National Aeronautics and Space Administration with named at Moffett NAS, Calif. Company now is considering a subproject version to meet military VTOL transport specifications.

Bendix Corp.'s Radio Electronics has developed a new radio receiver, control panel and isolation amplifier for light aircraft, according to C. R. Rose, sales manager. New unit is aimed at use in single-pilot, twin engine aircraft equipped for instrument flight systems.

ROCKET PROPULSION PROGRAM COORDINATORS

United Technology Corporation, on the San Francisco Peninsula, has immediate specific openings for highly qualified Program Coordinators who will monitor technical programs, assist in conducting periodic progress reviews, and assist in closely with project engineers and corporate management to assure fulfillment of program objectives. Requirements are: physical science or engineering degree (advanced degree preferred) and at least six months' experience in rocket propulsion related fields of research and development.

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NASA program-highlights

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Orbiting Astronomical Observatory—Standardized 2000 lb. vehicle. Its several instruments will detect and observe celestial bodies and distant stars



Allotment Growth of NASA Spacecraft in terms of weight of individual man earth vehicles



Lanch Vehicle—New and more powerful land-vehicle, chemical, electrical engine propulsion



Project Mercury—U. S.'s first manned satellite



Project Gemini—First test landing on moon. Conduct observations from stationary position



Project Prospector—Still testing in orbit. Most applications of area within 50 miles of landing point



Solar Observatory—200 to 300 lbs. payload and extended range vehicle to observe solar radiation

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NASA Langley Research Center • Hampton, Virginia

NASA Lewis Research Center • Cleveland 30, Ohio

NASA Marshall Space Flight Center • Huntsville, Alabama

NASA Wallops Station • Wallops Island, Virginia

WHO'S WHERE

(Continued from page 35)

Changes

Dr. A. Stuart Desbates, head of the newly established Power Conversion Department, Goodrich High Voltage Atmospheric Inc., Bingham, Utah, and **Dr. Ben V. Nalis**, head of the newly established Electronic Packaging Department, also have positions, manager of operations for CIVIC.

Ray A. W. C. Chaudhry (USC, etc.), director of communications Space Technology Laboratories, Inc., Los Angeles, Calif. Chaudhry has joined the Technical Staff of National Engineering Science Co., Pasadena, Calif.

William B. Burt, deputy director of Launch Vehicle Program, National Aeronautics and Space Administration, Washington, D. C. **Ernest L. Woodcock** has been appointed as the senior technical staff of the Electro-Optical Systems Division, Los Angeles, Calif.

John L. Davis, former technical systems supervisor of America, Hickory, N. Y.

Richard B. Ellis, assistant general manager Electronics & Conference Division, Tech Corp., Cincinnati, Ohio.

Dr. Seymour Stein and **Dr. James E. Stein**, senior scientists, Applied Research Laboratories, National Aeronautics and Space Administration, Goddard Space Flight Center, Maryland, have been appointed as senior scientists of General Telecommunications and Electronics Corp., Wallingford, Conn.

Jack O. Menden, chief application engineer, Data Corp., Memphis, Tenn.

Mr. Gen. Richard A. Grosser (USAF, etc.) has joined Hughes Corp., Little Rock, N. Y.

Robert D. Wilson, general manager, Sun Lab Corp., Anaheim, Calif.

Dr. Samuel J. Jorgensen, director, and **Dr. William F. Jorgensen**, director, Space Electronics Corp. have been named General and Control Laboratories, Glendale, Calif.

Robert R. R. R., general manager, Lin Engineering Division, Fairchild Camera and Instrument Corp., Stuart, N. Y.

Quentin G. T. T., program manager, ETO Systems and Traffic Control, electronic systems, Minneapolis Military Electronics Division, St. Paul, Minn.

Nathan J. Buchholz, manager, management and, Kellogg Industries Corp., Los Angeles, N. Y.

Federal Electric Corp., Pasadena, N. Y., senior consultant of International Telephones and Telegraph Corp., has appointed **Dr. E. E. Stewart**, senior project manager at the New York City, New York, office, Calif., and **T. J. Conner**, general manager, New York.

Charles A. Howell, Jr., representative of aerological operations, National Research Corp., Cambridge, Mass.

John H. Newland, public relations manager, Boeing Aircraft Co., Van Nuys Division, Van Nuys, Calif., replacing **Mr. Maynard C. C.**, resigned.

James S. Boynton, executive vice president in charge of public relations, Boeing Transport Division, Renton, Wash.

Herbert D. Dillards, director of new business, Boeing Corp., Detroit, Mich.

Electronic Systems Engineers

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- Development of Microwave Systems
- Signal Processing
- Ground Communications and Surveillance Systems
- Operations Research
- Radar Systems Design
- Radar Systems Design
- Radio Frequency Electronic Test Equipment
- Service Systems
- Solid State Devices
- Systems Analysis
- VHF/UHF Antenna Development

Electronic Engineers who are qualified, through education and experience, and who are seeking better opportunities to technically express themselves in any of the aforementioned fields, please forward resume to:

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Engineering Personnel Supervisor, Box AW-322
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Soviet U-2

As we might have suspected, the Russians had a U-2 before we developed one.

The Russian plane pictured below is the one photographed in 1944 in an aircraft it was a member of the U.S. Navy Air Force stationed at the American aircraft bombing base in Feltina (Ukraine).

The Soviet U-2 was designed originally by N. N. Polikarpov as an observation plane (like our own U-2). During the War (Second and Third) it was used for observation behind enemy lines, as a training plane, for reconnaissance work, and also carried light bombs along with rocket launchers.

The Soviet U-2 is described in *Planes All the World Aired* (1946 edition) as a single-engine biplane with a maximum speed of 170 kilometers per hour (41 mph) and a maximum ceiling of about 10,000 ft.

While the Russians dropped our U-2, they took very much of their own.

"This September night was cold and dark in Stalingrad. Everything had gone to seed in five to six weeks during which light had been going on in the city itself. The Soviet citizenry no longer came from work to work, and those heading to heading that the Germans were dead to leave at night for fear of being taken over. One day, one little U-2 'Junkies' in that area called, could be ordered to destroy the left wing of a building while one other soldier was emerging in right wing. They did their job, their work at night, and it was a hard job to see that they could stand it without all night long over the Germans and ship their little bombs one by one" (Faint. Kozlovsky, Moscow, Deyr and Nigler, p. 56).

FRANCIS D. DE LOZAN
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Amphibian Concept

I was intrigued and pleased to note that the president of a well-known company would come to your Letters column (AW Oct. 5, p. 126). However, I was amazed at Mr. Robert M. Boren (President, Los Cerk Marine Engineering

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Co. Van Ness, Calif.) business approach to our past industry difficulties.

If I am being and sharing that approach is not being applied, some FBI investigations will be just coming in their hands during investigation and closed our for a more realistic working a current defense contract. However, this current defense should reflect Mr. Boren said as far as working to me (the public) facts of his company's "confidential" proposal to the Army.

Mr. Boren did concede me that two points in that our "use" to not able to control the weather. Thus, points where put a severe limitation on weather operations and quite strongly within his company's technology concept. Early plans, in which in various from the sea is not explained, were made at planning and it is well-known fact that D-Day was a very difficult. Regarding D-Day, a solution was state will require the effect of the "one" side in control the weather.

Since the noted article (AW July 16, p. 12) revealed that MCMC proposed an amphibious capable of control and under amphibious operations, I find company submitted what I considered "constructive criticism," and then offered a number of suggestions to aid in improving the plan. I was astonished that all action of the company's "small team" as the industry. However, I am sure that no mention was made of a high performance RTDL (which proved itself changed with amphibious capability). It will conclude that no amphibious can be manufactured without a high level, but cannot meet the objectives, located there has (assumed problems) to present "high performance."

After the buildup in the aforementioned industry, however, I am amazed at Mr. Boren's comments that his company's amphibious operations were "a small portion of its capabilities." I am sure that all of the industry, proposed. We should be involved in amphibious operations in place to be the major method of delivery.

ing "less than of personnel and cargo to be impossible during 1,500 m. (500 ft.) less than over land." For its ground moving, I suppose the need of an aircraft with the strength/length requirements of an amphibious type airplane to accomplish the mission of a landplane with the added (possible) complexity of a seaplane.

After Mr. Boren revealed on first to a "public," he stated that his company will "cooperate with an advanced design" the last three and will "aim to solve them. Most point to him I still want the right of my company, regarding our last two points, plus the following:

(1) The problem of water operations which depends upon the fact that of "no." Active ideas after possible ways appear to prevent corrosion and possible to repeat engine failure.

(2) Directional control during precise water-based maneuvering.

(3) Possible engine change at sea is leaving ahead or abandonment of sea.

(4) Finding how the "large" ship submarines have been used, however, the old way that the need for a valid sea state is still a requirement.

(5) Possibility of preparation of flap-joint too during landing or takeoff.

I observed with pleasure that Mr. Boren's criticism to the company, the MCMC, is a capable of operating out of "small body of water" and did not push the open sea concept. Small bodies of water are naturally surrounded by a land area and naturally the water encompassed are considered to be quite safe.

Claude T. E. Mathews, USN Ret
Ft. Meade, Md.

Rocket Noise Case

Max I complained was on your editorial which on the air at Niagara Reg. it is. I think (AW Nov. 26, p. 50). The national is serious, it tends to be, and through depriving it points up the problem well by the public industry.

It has been decided in the last time to go ahead with the report, and the press is asking the advice of the Selects Council to come to its decision.

Bill Casper
Director, Miami, Fla.
The Air Force
Dennis, N. J.



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